A Comparison of the Level of Safety of Compliant Buildings: New Zealand Building Code Approved Document (C/AS1) Compared to the South African Deemed-To-Satisfy Standard (SANS 10400) – Fire Safety

by

Peter Jeffery Reddin

Supervised by

Dr. Michael Spearpoint

A project submitted in partial fulfilment of the requirements for the Degree of Master of Engineering in Fire Engineering

Department of Civil Engineering

University of Canterbury

Private Bag 4800

Christchurch, New Zealand

ABSTRACT

"Are South African Buildings as Safe as New Zealand Buildings?"

A person going into or using a building anywhere in the world has certain expectations as to the perceived and acceptable level of risk to life safety. There are also societal expectations and acceptability levels which are perhaps not explicitly stated. Building legislation in both New Zealand and South Africa appear to have similar goals, yet when applying the relative prescriptive document to a similar building in each country the perception is that one country has a higher level of safety over the other. Having worked for a number of years under both sets of building design regimes, the author was of the opinion that aspects of one prescriptive document has more stringent requirements than the other and that buildings in the one country thus had a higher apparent level of life safety than the other. The question was asked: How much difference is there in (fire) life safety for an occupant of a building in New Zealand compared to a building in South Africa? Is a similar building designed to a higher standard in one country as opposed to the other?

To test the author's hypothesis in a measured way a scoring system was required to quantify the relative level of safety. The comparison is carried out using the Fire Safety Index scoring system developed by McGhie. A spreadsheet analysis is carried out for similar building types (Building Use, Height, Fire Load and Number of Occupants) complying with each country's relevant acceptable solution or deemed-to-satisfy document using McGhie's weighted risk ranking model. Buildings are assessed across four Building Use Parameters (Purpose Group, Escape Height, Occupant Numbers and Fire Hazard Category). As the buildings assessed are very similar, the Building Use Scores are virtually identical; with some variations, for example, when occupant numbers are capped because of limitations on fire cell floor areas. The Fire Safety Features Score for each building is then assessed for the minimum requirements of the prescriptive documents across eight main category headings (Fire Barriers, Fire Alarm, Smoke Control, Building Fire Control, Emergency Power Supply, Communication System, Fire Service and Means of Escape) and a number of sub-categories. Once the attribute score is assigned and the

weighting applied the total score is summed and a numerical rating score is achieved for each building out of a possible maximum score of 5.

As approximately 63% of commercial buildings (in NZ) are single storey and a further 28% are two-storey's high, the discussion of the differences in score between the two sets of buildings will primarily focus on one and two storey buildings, and the scoring is weighted to account for the relative building stock, with averaging used for the various occupant loads. The results show that for equivalent Working Purpose groups (WL), Mercantile Occupancies (CM) and Residential Occupancies (SR) the South African buildings are safer than the New Zealand buildings. Occupancies which are Crowd Activities (CL) and Sleeping Accommodation (SA) are safer in New Zealand than in South Africa. The Working Moderate fire load (WM) occupancy is rated equal for both countries.

ACKNOWLEDGEMENTS

I would like to acknowledge the support of the following people and organisations which have provided invaluable support, assistance, and motivation during the time I have been busy completing my studies for the degree of Master of Engineering in Fire Engineering.

The New Zealand Fire Service Commission for their support of the ME Fire programme at the University of Canterbury, and in particular for the support of the Fire Service Commission Scholarship.

My employer, Peter Dunkin of Fire Designs Ltd who supported me with valuable advice and allowed me time away from work to complete the first year as a full-time student.

I would like to thank my supervisor, Dr. Michael Spearpoint for all his help and assistance throughout the time I have spent in Christchurch undertaking this course and in particular for his most valued input and guidance in this project.

I would like to acknowledge the invaluable mental and technical support I received from my classmates, in particular Chee Leong Ho.

Heartfelt thanks also go to my mother, Dawn Reddin, who helped out financially when times got tough while I was not earning any income and living away from home for extended periods.

My most sincere thanks and appreciation go to my wife, Linda and my sons, Andrew and Stephen, who had to keep the home fires burning while I was away enjoying the student life.

I would like to dedicate this project to the memory of my father, Arthur Reddin, who sadly passed away before he could join us in New Zealand.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

NOMENCLATURE and DEFINITIONS

Acceptable Solution	A building design solution that must be accepted as complying with the *New Zealand Building Code*
Alternative Solution	An alternative means of showing building compliance with Regulations C1 to C4 of the *New Zealand Building Code (NZBC)* Similar to *Rational Design*
Appeal	(RSA) Appeal to the *Review Board* against the decision of a *local authority* Similar to *Determination*
BCA	Building Consent Authority: an authority (person) registered to grant consents to carry out building work. Usually a local government entity such as a Territorial Local Authority.
BRANZ	Building Research Association of New Zealand
C/AS1	Acceptable Solution for showing building compliance with the Regulations C1 to C4 of the *New Zealand Building Code (NZBC).* When all relevant items have been complied with the *BCA* is obliged to issue building consent. Similar to *Deemed to Satisfy*
Division	(RSA) "A portion of a building separated from the remainder of such building by one or more separating elements". [1] Similar to *Firecell.*

Deemed to Satisfy (Rule)	(RSA) "A non-mandatory provision which describes a method of design or construction that is deemed to comply with a particular functional regulation". [1] A means of showing building design compliance. Similar to *Acceptable Solution*.
Emergency Route	(RSA) "That part of an escape route which provides fire protection to the occupants of any building and which leads to an escape door". [1] Similar to *Safe Path*
Escape Door	(RSA) "That door in an escape route which, at ground level leads directly to a street or public place or to any approved open space which leads to a street or public place". [1] Similar to *Final Exit*
Escape Route	(RSA) "The entire path of travel from the furthest point in any room in a building to the nearest escape door and may include an emergency route". [1]
Exit Door	(RSA) "Any door that is a component of an escape route from any room". [1]
Feeder route	(RSA) "That part of an escape route which allows travel in two different directions to the access doors to at least two emergency routes". [1] Similar to *Open Path*
Final Exit	"The point at which an *escape route* terminates by giving direct access to a *safe place*". [2]
Firecell	"Any space including a group of contiguous spaces on

	the same or different levels within a building, which is enclosed by any combination of fire separations, external walls, roofs, and floors". [2] Similar to *Division.*
Local Authority	(RSA) City, Regional or Local government body exercising powers in terms of the *NBR.* Similar to *BCA.*
NBR	(RSA) National Building Regulations (and Standards Act, No. 103 of 1977)
NZ	New Zealand
NZBC	New Zealand Building Code
Protected Path	"That portion of an exitway within a firecell which is protected from the effects of smoke by smoke separations". [2]
RSA (or SA)	Republic of South Africa; South Africa(n)
Rational Assessment	(RSA) "Assessment by a competent person of the adequacy of the performance of a solution in relation to requirements including, as necessary, a process of reasoning, calculation and consideration of accepted analytical principles, based on a combination of deductions from available information, research and data, appropriate testing and service experience". [1]
Rational Design	(RSA) "Any design by a competent person involving a process of reasoning and calculation and which may include a design based on a standard or other suitable

	document". [1] Similar to *Alternative Solution*
Review Board	(RSA) A statutory body set up under the auspices of the *SABS* to hear appeals by persons who feel aggrieved by decisions of a local authority. Board consists of: A Chairman designated by the Minister, and Two persons appointed by the chairman for any particular appeal. Similar to *Determination*
SABS	South African Bureau of Standards
SABS 0400	South African Bureau of Standards Code of Practice for The Application of the National Building Regulations Now called SANS 10400
SANS	South African National Standard
SANS 10400	South African National Standard for The Application of the National Building Regulations Previously known as SABS 0400
Safe Path	"That part of an exitway which is protected from the effects of fire by fire separations, external walls, or by distance when exposed to open air". [2] Similar to *Emergency Route*
Safe Place	"A place of safety in the vicinity of a building, from which people may safely disperse after escaping from the effects of a fire. It may be a place such as a street, open space, public space or an adjacent building. [2]

1. INTRODUCTION

1.1. Background

Buildings must be designed and constructed to meet the requirements of the relevant building legislation applicable to the jurisdiction in which the building is to be constructed. In particular the provisions for satisfying the requirements for fire safety are important to fire engineers. Fire safety for building projects undertaken in one country are sometimes formally or informally compared to the design requirements for similar projects in another country. Having worked extensively in the fire safety field in South Africa and more recently in New Zealand, this author naturally makes informal comparisons of the perceived level of safety offered by buildings complying with the acceptable solution C/AS1 [2] in New Zealand to what is perceived to be the equivalent level of safety offered by a similar building complying with the South African building regulations deemed-to-satisfy rules of SANS10400 [1] . The perception from a qualitative point of view is, rightly or wrongly, that the South African buildings have a higher level of safety than New Zealand buildings.

Fire behaviour is governed by the laws of science and physics, not man-made rules. Legislation attempts to quantify and counter natural fire behaviour by providing rules, regulations and standards which must be adhered to in order to gain building consent or approval. The base legislations for both South Africa and New Zealand appear to have similar goals, while the regulations and standards for fire safety in building construction and design for two buildings of similar purpose, design and construction (one in each country) appear to have different acceptable levels of safety.

1.2. Research Aims

This project will compare the apparent level of safety of a range of buildings which meet the minimum requirements of the New Zealand approved document C/AS1 with the apparent level of safety of buildings which are designed to meet the minimum requirements of the South African deemed-to-satisfy rules of SANS10400.

1.3. Scoring Methodology

In order to objectively rate buildings for comparison, a method of scoring the fire safety features and attributes of similar buildings in both countries is required. This project will use

a scoring system or Fire Safety Index developed by McGhie [3], a previous MEFE student at the University of Canterbury to firstly determine the fire safety index score of buildings in both countries. This will then enable a numerical comparison to be made to determine which country's buildings have the highest fire safety index score.
McGhie's Fire Safety Index method produces a single numerical index value for buildings when assessed against a set of pre-determined criteria. The Fire Safety Index produces a comparative score and not an absolute value.

The criteria used in evaluating the fire safety of buildings encompass in the first instance an assessment of the building with regard to the Building Use. The second part of the scoring system evaluates the fire safety features which are required for the building in question. These are dealt with in greater detail in Section 3 (Building Use) and Section 4 (Fire Safety Features). The results of the comparative analysis using McGhie's Fire Safety Index Method will enable a score card to be kept which will allow this author's hypothesis to be quantitatively proved or disproved.

It is noted that when comparing the relevant level of safety provided by the deemed-to-satisfy or acceptable solution documents of each country, the assessments of whether an item in the relevant document is applicable to the building type under consideration is based entirely on this author's interpretation of the relevant document based on real life application of the documents. As the comparisons have been based on assessing whether a particular item is comparable across the two documents rather than on an actual building design it is possible that another researcher could attain a different result when an actual building design is compared. It is also possible that another researcher could attain a different score for the comparisons based on differing interpretations of the two documents. It is because different fire engineers have differing opinions and interpretations that review processes and appeals processes have been put in place by the regulatory bodies to resolve such differences. Further, it is acknowledged that this author has attempted to take all factors into account in preparing the comparisons. The fact that something is only rarely used does not detract from the fact that it still appears in the relevant document and could still be used if the building design warranted its use. The theoretical comparison is done to achieve an acceptable building design that would satisfy the minimum requirement and uses all available concessions to achieve this.

1.4. Basis for McGhie's Fire Safety Index Method

In developing the Fire Safety Index Method, McGhie investigated several other scoring systems before developing the Fire Safety Index Method. These included Boyes' Risk Ranking of Buildings for Life Safety [4], the NFPA 101A Fire Safety Evaluations System (FSES) [5] and the Swedish Fire Risk Index Method – Multi Storey Apartment Buildings (FRIM-MAB) developed by Karlsson and Larsson [6] at Lund University.

Boyes' Risk Ranking of Buildings was developed as a tool for the New Zealand Fire Service to use when carrying out building inspections, whereby a higher score is recorded for a building which is ranked as more at risk. The Fire Safety Evaluation System developed by the NFPA is a tool for comparative assessment of performance based solutions against the prescriptive requirements of the NFPA 101 Life Safety Handbook [7] and is also used in conjunction with NFPA 101A [5], Guide on Alternative Approaches to Life Safety. The Swedish Fire Risk Index method uses similar criteria to McGhie's method in assessing the risk in low rise apartment buildings.

2. REGULATORY FRAMEWORK

2.1. Legislation and Regulation

Each country has a regulatory framework which governs the design, approvals process, construction, operation and maintenance and other matters pertinent to buildings and structures.

Earlier building regulation generally evolved from past experience, especially from historic events and in the case of fire, regulations were based on fires which involved significant fire losses, both from a loss of human life and from property losses. Particular events that have had an impact on building (fire) regulations are events such as the Great Fire of London (September 1666) which caused the property destruction of tens of thousands of buildings and loss of life (six recorded deaths); the Triangle Shirtwaist factory fire (March 1911) in which around 140 people died and 70 were injured. Although the Ballantyne's Department Store fire in Christchurch (18 November 1947) killed 41 people and a private members bill was introduced to further regulate fire safety, the bill was never promulgated into law [8].

Building regulations in both South Africa and New Zealand were generally promulgated by town and city councils in the form of local authority Building Control Bylaws. The proliferation of these bylaws by various local authorities meant different rules and regulations across the country, and sometimes resulted in nearly similar buildings, only separated by a town or city boundary from another, being subject to different rules and regulations.
These early bylaws were usually prescriptive in nature. These prescriptive regulations had the advantage of creating a level playing field and are generally straightforward and easy to implement. On the other hand this also created difficulties for architects and designers by virtue of differing standards in different jurisdictions. In addition there was no opportunity for innovation or change and no allowance was made for new methods or technologies.
This proliferation of a multitude of different rules and regulations in different parts of the same countries soon became untenable and efforts were undertaken to standardise and regularise legislation to try and achieve some degree of uniformity.

2.2. Enabling Legislation

The enabling legislation for the requirements and standards under which buildings must be erected in South Africa is the National Building Regulations and Building Standards Act, No.

103 of 1977 which was assented to on the 22nd of June 1977. The legislation had an initial commencement date of the 1st of September 1985[9]. This primary enabling legislation was initially amended by the Standards Act, No. 30 of 1982 [10]. Further amendments to the Act were promulgated as: the National Building Regulations and Building Standards Amendment Act, No. 36 of 1984 [11]; the National Building Regulations and Building Standards Amendment Act, No. 62 of 1989 [12], and the National Building Regulations and Building Standards Amendment Act, No. 49 of 1995 [13].

In New Zealand the enabling legislation is the Building Act, 2004, No 72, (as at 01 February 2010).

2.3. Legislative Intent

The preamble to the South African National Building Regulations and Standards Act states "To provide for the promotion of uniformity in the law relating to the erection of buildings in the jurisdiction of local authorities; for the prescribing of building standards; and for matters connected therewith" [9].

The purpose of the New Zealand Building Act, 2004, No 72 [14] is stated as "The purpose of this Act is to provide for the regulation of building work, ..., and the setting of performance standards for buildings, to ensure that –

(a) People who use buildings can do so safely and without endangering their health; and
(b) Buildings have ...; and
(c) People who use a building can escape from the building if it is on fire; and
(d) Buildings are ... sustainable development."

2.4. Prescriptive Regulations

Earlier legislation, especially the local government bylaws are generally in the form of prescriptive regulations. In this form of regulation the requirement is stated in the form of what must be done, (method and material), without allowing the option of the designer being able to choose from different methods or materials.

In a prescriptive regulation, the requirement for an external fire rated wall may be stated as "Any external wall of a building shall have a minimum thickness of 230mm and shall be constructed of well-burnt clay brick bedded in a cement mortar made of 1 part of cement to 4 parts of river sand" (commentary to Part A of SANS 10400 [1]).
Although the statement of such a prescriptive regulation is simple easy to understand and easy to enforce, it does not necessarily specifically state the underlying goal (function) of the regulation, nor does it allow for any deviation from the very strict and narrow requirement. In this form, only a clay brick would be permitted and the wall would have to meet the required thickness and be constructed with the prescribed cement mortar mix. Alternatives are not allowed, and innovation is not encouraged or permitted.

2.5. Functional or Performance Based Regulations

Functional or performance based regulations state the performance requirements of the building elements without stating the method by which the requirement is to be achieved. This leaves it up to the designer to determine by which means the requirements will be achieved. In this way innovative materials or methods can be used in a building construction as long as it can be shown that the methods can achieve the requirements of the functional or performance based regulation.

2.6. Deemed-to-Satisfy Rules or Acceptable Solutions

In both South Africa and in New Zealand, the change to countrywide (national) legislation and functional (performance) based regulations have brought in Deemed-to-Satisfy Rules or Acceptable Solutions. These provide a set of (simple) prescriptive rules which provide a conventional way to achieve compliance with the requirements of the regulations.
For the issues pertaining directly to fire safety in buildings the Acceptable Solutions in New Zealand are commonly referred to as C/AS1, and in South Africa they are generally known as Part T of SANS 10400, although many practitioners still refer to the document as SABS 0400.

2.7. Rational Designs or Alternative Solutions

Both South Africa and New Zealand have provisions within the relevant building legislation for designers to follow a non-prescriptive route to meet the minimum requirements of the legislation.

The Regulations published on the 30th of May 2008 specifically states how any alternative designs are to meet the requirements of the South African National Building Regulations. This is stated under Regulation AZ.4 which reads as follows:

"**AZ.4 Complying with the requirements of the National Building Regulations**

1) The requirements of the National Building Regulations shall be complied with by:
    a) Adhering to the requirements of all the prescriptive regulations; and
        i) Adopting building solutions that comply with the requirements of the relevant part of SANS 10400; or
        ii) Reliably demonstrating, or predicting with certainty, to the satisfaction of the appropriate local authority, that an adopted building solution has an equivalent or superior performance to a solution that complies with the requirements of the relevant part of SANS 10400" [15].

The New Zealand legislation does not appear to specifically state to what standard any alternative solution is to be judged, although the Department of Building and Housing has, in various Determinations stated that the level of safety of buildings designed using an alternative approach should be measured against the benchmark set by the Acceptable Solutions C/AS 1. An example of a Determination in which this approach is used is Determination 2004/5 where the Building Industries Authority (the precedent to the Department of Building and Housing) states:

"5.2.3 The Authority sees the acceptable solution C/AS1 as an example of the level of fire safety required by the building code. Any departure from the acceptable solution must achieve the same level of safety if it is to be accepted as an alternative solution complying with the building code."[16].

Although the determinations do not set any form of legal precedent, and this is clearly stated on the Department's website [17], the website also states that the Department takes into account the outcomes and decisions of previous determinations if the new determination is sufficiently similar to a previous determination. The Department appears to treat earlier decisions as precedent setting and would not issue a new determination which is at odds with

those previously issued, unless there is a clear change in Law or Regulation, or the Acceptable Solutions which dictates a change of approach.

2.8. Appeal Process

In South Africa, where any person who has made application for a building approval and this is refused by the local authority, or has received any statutory notice of prohibition from a local authority, or who disputes the interpretation or application by a local authority of aspects of the national building regulations and such person feels aggrieved by, or does not accept such decision, that person can appeal to a review board. The process set up in terms of the National Building Regulations and Standards Act (No. 103 of 1977) for dealing with disputes is stated in the Act under Section 9 as:

> **"9. Appeal against the decision of local authority**
>
> (1) Any person who –
>
> (a) Feels aggrieved by the refusal of a local authority to grant approval referred to in section 7 in respect of the erection of a building;
>
> (b) Feels aggrieved by any notice of prohibition referred to in section 10; or
>
> (c) Disputes the interpretation or application by a local authority of any national building regulation or any other building regulation or bylaw,
>
> May, within the period, in the manner and upon payment of the fees prescribed by regulation, appeal to a review board." [9].

In New Zealand, the Department of Building and Housing (DBH) administers a "Determination" process, whereby persons with an interest in a building can apply for a determination against any decision of the Building Consent Authority (BCA).
Persons with an interest in a building are generally the building owners or developers, owners of units within a building, neighbouring property owners, or a statutory body such as the New Zealand Fire Service (NZFS) Commission. As previously stated, the Determinations, whilst binding on the parties to the Determination, do not set any form of legal precedent; although Determinations are generally accepted by building designers as precedent-setting and not only as purely legal decisions for a particular building. The publishing by the DBH of each concluded Determination makes these available to the public for perusal. The publication of Determinations serves as an interpretation of the relevant point in law or regulation. By

issuing Determinations, the DBH can also use these as trend setters and indirectly influence the direction of building design.

3. BUILDING USE

3.1. Building Use Classification

The proposed use of a building is essential for allowing the classification of a building. This classification of building use is the cornerstone for implementing fire safety strategies in buildings. If the proposed use and classification of a building were not known, then it would not be possible to design and build a cost-effective building, as every possible fire safety measure would need to be included to cater for each and every possible use or eventuality. Buildings are therefore classified by the relevant building control legislation into broad occupancy types or building purpose groups. This classification or grouping allows for buildings with similar features, uses, hazards and risks to be dealt with in a satisfactory manner.

McGhie in his thesis [3] calls for the building to be ranked according to each of the following scoring categories:
Purpose Group – Building Use 1 (BU1),
Building Escape Height – Building Use 2 (BU2),
Occupant Numbers – Building Use 3 (BU3), and
Fire Hazard Category – Building Use 4 (BU4).

According to McGhie's system, 18.79% of the total fire safety index score is allocated for the Building Use Score of each particular building.

3.2. Purpose Group

The proposed use of a building allows for the classification of a proposed building into broad categories. The classification of building use results in buildings with similar characteristics being grouped together for the purposes of determining the requirements for fire safety measures.

In New Zealand, the classification of buildings is done in terms of 'Purpose Groups' and is primarily carried out using Table 2.1 of Part 2 of C/AS1. (Refer to Appendix A – C/AS1 – Table 2.1: Purpose Groups on page 143 of this report).The Purpose Group is further refined by the inclusion of a Fire Hazard Category Classification (FHC) (Refer to Appendix C – C/AS1: Fire Hazard Categories on page 147 of this report).

The classification of building use in South Africa is done according to Table 1 – Occupancy or Building Classification of Part A – Administration of SANS 10400. (Refer to Appendix B – SANS 10400 – Part A, Table 1: Occupancy or Building Classification on page 145 of this report). The fire load (Low, Moderate or High) of the particular Occupancy is predetermined for the designer by virtue of the relative ranking of the Occupancy within the Occupancy or Building Classification.

The table is divided into nine main building occupancy categories. These are
A – Assembly (Indoor and Outdoor)
B – Commercial Services
C – Exhibition Hall and Museum
D – Industrial
E – Institutional (Detention, Hospital)
F – Shops and Wholesale
G – Offices
H – Accommodation and Hospitality (Hotel, Housing etc.)
J – Storage (including parking for more than 10 motor vehicles)

Each occupancy group is further divided into sub-classifications which are broadly based on the fire hazard category or risk associated with the occupancy or building use. The class of occupancy generally follows the format of being listed from highest fire hazard category to lowest fire hazard category, and in the case of Table 1 of SANS 10400 the highest fire hazard classification is denoted by a 1 (one) in each grouping of occupancies. This is in contrast to C/AS1 which classifies the fire hazard from 1 (low) to 4 (high).

The following list is reproduced from Table 1 of Part A of SANS 10400 and gives the breakdown of the Occupancy or Building use classification. For ease of reference the equivalent New Zealand Purpose Group is given in *Italics*. Please note that the equivalent

purpose group is based on this author's judgement and interpretation of the two prescriptive documents to broadly define which buildings equate with each other.

A – Assembly

A1 Entertainment and public assembly *(CS & CL – FHC 2)*

Occupancy where persons gather to eat, drink, dance or participate in other recreation.

A2 Theatrical and indoor sport *(CS & CL – FHC 2)*

Occupancy where persons gather for the viewing of theatrical, operatic, orchestral, choral, cinematographical or sport performances.

A3 Places of instruction *(CS & CL – FHC 1 or 2)*

Occupancy where school children, students or other persons assemble for the purpose of tuition or learning

A4 Worship *(CS & CL – FHC 1)*

Occupancy where persons assemble for the purpose of worshipping

A5 Outdoor Sport *(CO – FHC 1)*

Occupancy where persons view outdoor sports events

B – Commercial Services

B1 High risk commercial service *(WH or WF – FHC 4)*

Occupancy where a non-industrial process is carried out and where either the material handled or the process carried out is liable, in the event of fire, to cause combustion with extreme rapidity or give rise to poisonous fumes, or cause explosions

B2 Moderate risk commercial service *(WH – FHC 3)*

Occupancy where a non-industrial process is carried out and where either the material handled or the process carried out is liable, in the event of fire, to cause combustion with moderate rapidity but is not likely to give rise to poisonous fumes, or cause explosions.

B3 Low risk commercial service *(WL – FHC 1 or 2)*

Occupancy where a non-industrial process is carried out and where neither the material handled nor the process carried out falls into the high or moderate risk category.

C – Exhibition Hall and Museum

C1 Exhibition hall *(CM – FHC 2)*

Occupancy where goods are displayed primarily for viewing by the public.

C2 Museum *(CS & CL – FHC 1)*

Occupancy comprising a museum, art gallery or library

D – Industrial

D1 High risk industrial *(WH or WF – FHC 4)*

Occupancy where an industrial process is carried out and where either the material handled or the process carried out is liable, in the event of fire, to cause combustion with extreme rapidity or give rise to poisonous fumes, or cause explosions.

D2 Moderate risk industrial *(WM – FHC 3)*

Occupancy where an industrial process is carried out and where either the material handled or the process carried out is liable, in the event of fire, to cause combustion with moderate rapidity but is not likely to give rise to poisonous fumes, or cause explosions.

D3 Low risk industrial *(WL – FHC 1 or 2)*

Occupancy where an industrial process is carried out and where neither the material handled nor the process carried out falls into the high or moderate risk category.

D4 Plant room *(IA or ID – FHC 1 or 3)*

Occupancy comprising usually unattended mechanical or electrical services necessary for the running of a building.

E – Institutional (Detention, Hospital)

E1 Place of detention *(SD – FHC 1)*

Occupancy where people are detained for punitive or corrective reasons or because of their mental condition.

E2 Hospital *(SC or SD – FHC 1)*

Occupancy where people are cared for or treated because of physical or mental disabilities and where they are generally bed-ridden.

E3 Other institutional (residential) *(SC or SD – FHC 1)*

Occupancy where groups of people who either are not fully fit, or who are restricted in their movements or their ability to make decisions, reside or are cared for.

E4 Health care *(SC or SD – FHC 1)*

Occupancy which is a common place of long term or transient living for a number of unrelated persons consisting of a single unit on its own site who, due to varying degrees of incapacity, are provided with personal care services or are undergoing medical treatment.

F – Shops and Wholesale

F1 Large shop *(CM – FHC 2 or 4)*

Occupancy where merchandise is displayed and offered for sale to the public and the floor area exceeds 250 m^2.

F2 Small shop *(CM – FHC 2)*

Occupancy where merchandise is displayed and offered for sale to the public and the floor area does not exceed 250 m^2.

F3 Wholesalers' store *(CM – FHC 2)*

Occupancy where goods are displayed and stored and where only a limited selected group of persons is present at any one time.

G – Offices

G1 Offices *(WL – FHC 2)*

Occupancy comprising offices, banks, consulting rooms and other similar usage.

H – Accommodation and Hospitality (Hotel, Housing etc.)

H1 Hotel *(SA – FHC 1)*

Occupancy where persons rent furnished rooms, not being dwelling units.

H2 Dormitory *(SA – FHC 1)*

Occupancy where groups of people are accommodated in one room.

H3 Domestic residence *(SR – FHC 1)*

Occupancy consisting of two or more dwelling units on a single site.

H4 Dwelling house *(SH – FHC 1)*

Occupancy consisting of a dwelling unit on its own site, including a garage and other domestic outbuildings, if any.

H5 Hospitality *(SA – FHC 1)*

Occupancy where unrelated persons rent furnished rooms on a transient basis within a dwelling house or domestic residence with sleeping accommodation for not more than 16 persons within a dwelling unit.

J – Storage

J1 High risk storage *(WH or WF – FHC 4)*

Occupancy where material is stored and where the stored material is liable, in the event of fire, to cause combustion with extreme rapidity or give rise to poisonous fumes, or cause explosions.

J2 Moderate risk storage *(WM – FHC 3)*

Occupancy where material stored and where the stored material is liable, in the event of fire, to cause combustion with moderate rapidity but is not likely to give rise to poisonous fumes, or cause explosions.

J3 Low risk storage *(WL – FHC 1 or 2)*

Occupancy where the material stored does not fall into the high or moderate risk category.

J4 Parking garage *(IA – FHC 1)*

Occupancy used for storing or parking of more than 10 motor vehicles.

3.3. Building Height

McGhie [3] has based his risk ranking scoring system for the New Zealand buildings on buildings ranging from above the 4 metre escape height and included the full spectrum to include buildings with an escape height of over 58 metres which accordingly matched the six building escape height division classifications used in Table 4.1 of C/AS1[2].

This author obtained some statistical data for commercial buildings from Page [18], the Economist Manager at BRANZ, via personal communication. The data obtained shows that approximately 63% of the New Zealand building stock consists of single storey buildings (Escape Height = 0 metre). A further approximately 28% of the building stock consists of two storey buildings which have an escape height of < 4.0 metres. All other buildings of two or more storeys (escape height > 4.0 metres) make up less than 10% of the New Zealand building stock. The breakdown of this building stock distribution is shown in Figure 1 – New Zealand Building Stock (Number by Storeys) and Figure 2 – New Zealand Building Stock (% by Storeys).

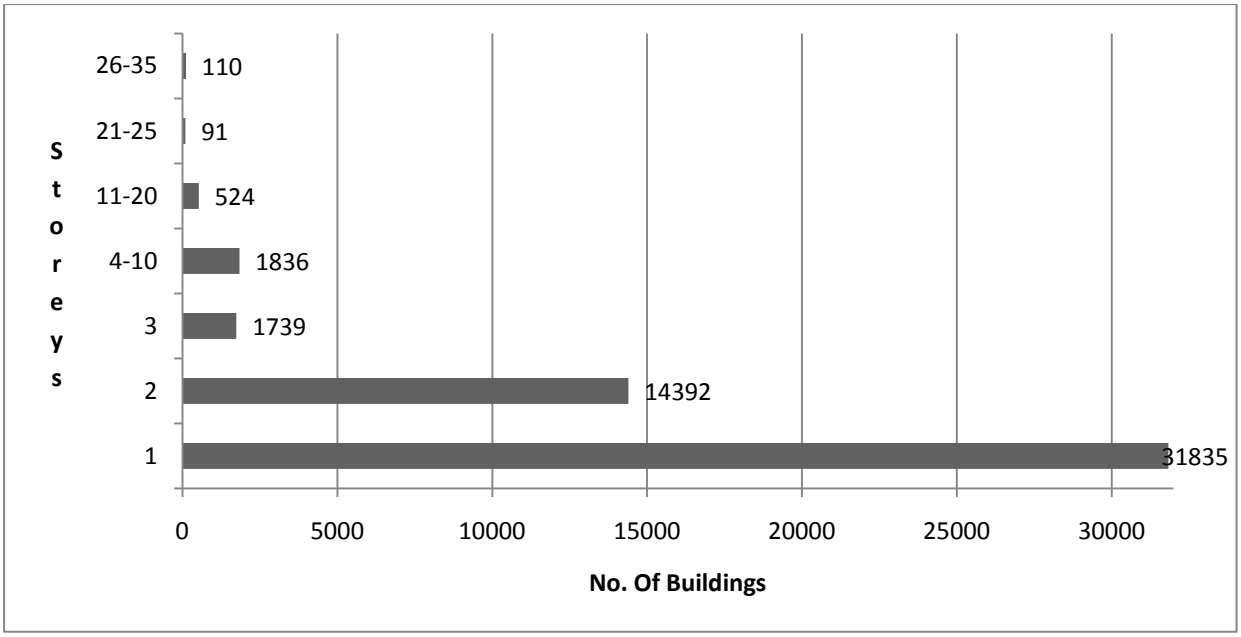

Figure 1 – New Zealand Building Stock (Number by Storeys)

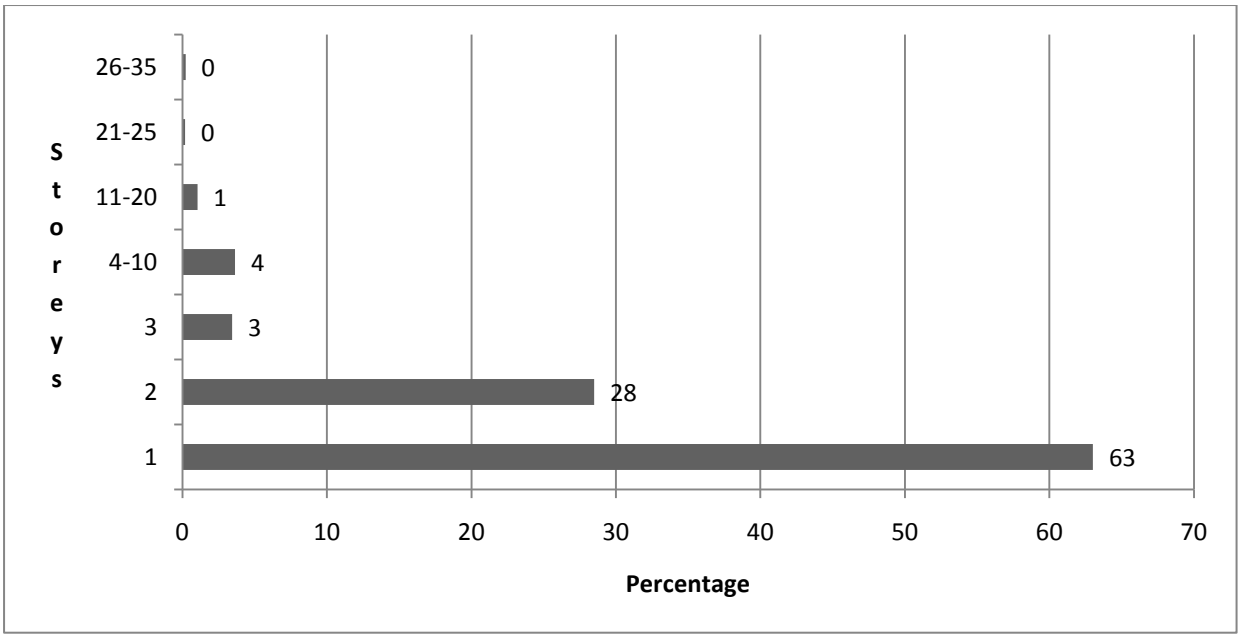

Figure 2 – New Zealand Building Stock (% by Storeys)

No equivalent data was obtained to compare to the South African building stock, but by this author's personal observation the trend in South Africa is similar to that in New Zealand. There are small pockets in the central business districts of towns and cities that have high rise (over two storeys) buildings, but by far the majority of South African buildings are also

single and double storey. Both countries have relatively low population densities and neither is hard pressed for land such as Singapore or Hong Kong. This author therefore feels confident in accepting that in the two countries under consideration, the large majority of buildings are two storeys or lower, with less than 10% of all buildings constructed with building heights in excess of 4.0 metre escape heights (greater than two storeys above ground level).

In light of this it was felt prudent to extend the building height range which McGhie had analysed [3] to include buildings at 0 metre escape height (ground floor level) and buildings with an escape height of less than 4 metre escape height (two storey). This will more accurately test the author's assumption that the buildings in one country are safer than those of the other country.

McGhie's risk ranking model [3] uses an Attribute Score rating with a maximum score of 5 for building height. For the purposes of the comparisons being carried out in this analysis the maximum points score available for the Building Use Scoring is kept at 5 for the additional building height categories, even though the general scheme of the risk ranking model should increase as the building height decreases. Although this has an effect on the Total Fire Safety Index Score it does not have an adverse effect on the outcome of this analysis, as this is a comparative analysis of similar buildings in the two countries, and any potential increase in scoring if a different Attribute Score was used would be the same for buildings in both countries, therefore the maximum Attribute Score is kept at 5.

Furthermore, as the South African building regulations do not have any differentiated fire safety requirements for building above the maximum height category of 33m it was deemed necessary to limit the height range of buildings under comparison to those falling into the maximum height category of 33m, as any increase in height would not require additional fire safety precautions and the only differences in scoring would be the marginal reduction in building use scores as the height increased. This is also considered to be reasonable, given that the New Zealand building stock (and by observation, also South African building stock) has less than 10% of buildings being three storeys and higher (Escape height over 4 metres).

3.4. Occupant Densities or Design Population

Once the general building type or occupancy is determined, the next factor that should be considered by the designer is the occupant load which is expected within the proposed building, as this also affects the requirements for fire safety features which may be necessary, especially in regard to escape routes sizing and location. The determination of the occupant load for the fire cell division is a factor in determining the size of the firecell or division, which in turn, is impacted on by the maximum permissible floor area size of the firecell division. This in turn results in a trigger for determining what fire safety precautions are required for the firecell division for example automatic sprinkler systems, or by reverse consequence have an impact on the maximum design occupant load for the firecell division.

With regard to building occupant loads, the work carried out by McGhie [3] used the occupant load tables and fire safety precautions from C/AS 1 for occupant loads starting with the 100 person occupant load. It is noted that C/AS1 has reduced fire safety precaution requirements for occupant loads not exceeding 50 people. Although no figures were obtained for actual building occupant loads, logic also says that a greater number of buildings are erected catering for smaller occupant loads than are constructed for large occupant loads. It was thus deemed prudent to extend the analysis to include buildings designed for less than 50 people.

McGhie's risk ranking model [3] uses an Attribute Score rating with a maximum score of 5 for occupant load. For the purposes of the comparisons being carried out in this analysis the maximum points score available for the Building Use Scoring is kept at 5 for the additional (lower) occupant load categories analysed, even though the general scheme of the risk ranking model should increase as the occupant load decreases. Although this has an effect on the Total Fire Safety Index Score it does not have an adverse effect on the outcome of this analysis, as this is a comparative analysis of similar buildings in the two countries, and any potential increase in scoring if a different Attribute Score was used would be the same for buildings in both countries, therefore the maximum Attribute Score for building occupant load is kept at 5.

In South Africa the design population of a room or storey, or part thereof is taken as the actual population of the area in question where the actual population is known, or the design occupant load (population) of a room or storey is calculated from Table 2 – Design

Population of Part A – Administration of SANS 10400. (Refer to Appendix F – SANS 10400 – Part A, Table 2: Design Population on page 151 of this report). In contrast to the case with New Zealand, the South African standard regulates the provision of such things as emergency lighting on the total building occupant load.

In New Zealand, the occupant loads of the building are determined from Table 2.2 of C/AS1. (Refer to Appendix E – C/AS1 – Table 2.2: Occupant Densities on page 149 of this report). The occupant load is normally based on the floor area of the firecell multiplied by the occupant density which is prescribed in Table 2.2 and is shown as users per square metre (Users/m^2). C/AS1 does permit deviations from the Table where different (usually lower) occupant loads can be substantiated to the Building Consent Authority. The occupant load is a determining factor in deciding what fire safety precautions are to be installed in the building, the number and size of escape routes, door hardware and fire alarm types amongst others. The fire safety precautions required are generally based on the population of the firecell, and not necessarily on the total building population load.
The occupant densities used in the analysis are also open to interpretation and actual building use. For example in the case of the New Zealand CM assessment an occupant density of 0.1 users per m^2 has been selected. This is acceptable for use when the building concerned is "Shop Spaces for Furniture, floor coverings, large appliances, building supplies and Manchester". If the building was a different type of shop space then an occupant density of 0.3 users per m^2 would be appropriate.

3.5. Fire Hazard Categories

In the South African deemed to satisfy document SANS 10400 [1], there is neither direct reference to the fuel loading within the building nor any requirement to calculate or assess the fire load, however Table 2 of Part T – Safety Distances – divides the various occupancy classes into categories which appear to be directly determined from the fire load assumed for each occupancy category. (Refer to Appendix D – SANS 10400 – Part T, Table 2: Safety Distances on page 148 of this report). These fuel loads are referred to in terms of the timber equivalent fire load (kg/m^2). The commentary to this table also states that the fire load can be expressed in terms of the calorific value (MJ/m^2). The commentary also gives conversion factors which are used when converting from one expression to the other. When converting

from kilograms per square metre to mega joules per square metre the conversion factor is 18, and when converting from MJ/m^2 to kg/m^2 a conversion factor of 0.056 is used.
For the purposes of this analysis the relative comparative fire hazard categories used are listed in Table 1 – Equivalent Fire Loads.

Occupancy Class of Division (SANS 10400)	**Maximum fire load (kg/m^2) (timber equivalent)**	**Equivalent FLED (MJ/m^2)**	**Equivalent C/AS1 Fire Hazard Category (FHC)**
A1; A2; A3; A4; A5 B3; C2; D3; D4; E1; E2; E3 G1; H1; H2; H3; H4; J1; J2;	25	450	1
B2; C1; D2; F1; F2; F3; J2	25 – 50	450 – 900	2
B1; D1; J1	> 50	> 900	¾

Table 1 – Equivalent Fire Loads

The New Zealand approved document C/AS1 Table 2.1 specifies which fire hazard category is to be used for each purpose group. The fire hazard categories are described in the comment to Part 2.2.1. This describes the fire hazard categories which are to be used in determining the various fire safety measures which are to be incorporated in the firecells of buildings.
The fire load energy density is one of the main factors in determining the fire hazard category and is determined by the calorific values of combustible materials within the building. The

fire load energy density used in New Zealand is expressed as mega joules of energy per square metre of floor area (MJ/m^2). (See Appendix C – C/AS1: Fire Hazard Categories on page 147 of this report). The fire load energy density for each fire hazard category is shown in Table 2 – Fire Hazard Categories.

Fire Hazard Category (C/AS1)	Range of FLED (MJ/m^2)	Design Value of FLED (MJ/m^2)
1	0 – 500	400
2	501 – 1000	800
3	1001 – 1500	1200
4	> 1500	

Table 2 – Fire Hazard Categories

3.6. Firecell Size – Maximum Division Area

In South African buildings, the maximum division area size of a firecell is restricted by Table 3 of Part T of SANS 10400. This in turn restricts the maximum occupant loading in any division (firecell) and in turn has implications on the requirements for the building. (Refer to Appendix G – SANS 10400 – Part T, Table 3: Maximum Division Area, m^2 on page 152 of this report). Permitted maximum floor areas stated in the Table vary, and while some building occupancy classifications have unlimited permissible areas, others have restricted areas when no fixed fire suppression equipment (usually automatic fire sprinklers) is installed. Further restrictions are placed on maximum floor areas based on whether the firecell division is situated at ground floor level or at other escape heights.

The comparisons will therefore take into account the maximum occupant load permitted as calculated from the maximum permissible areas and take into account the provision or otherwise of a fixed automatic fire extinguishment system (sprinklers).

In New Zealand the firecell floor area limits are prescribed by Paragraph 4.2.3 of the approved document C/AS1. This specifies firecell floor area limits for unsprinklered firecells to which an “S” rating applies. Single floor firecells may be of unlimited floor area where effective venting is provided.

For single level buildings to which an S rating applies, where the occupant load would ordinarily push the firecell floor area above the threshold for requiring the installation of sprinklers, the effective venting option framed in C/AS1 Paragraph 4.2.4 has be scored as "Automatic Natural Ventilation". This occurs, for example, in the WL purpose group, occupant load 1000 people.

It is to be noted that in some cases the relevant firecell floor area of buildings under comparison appear to be at opposite ends of the spectrum. This occurs, for example, where the New Zealand CL building with an occupant load of 1000 people has an area of $1000m^2$ and a South African C2 Museum with the same occupant load has an area of $20,000m^2$. This is because McGhie's Fire Safety Index system is based on the occupant load divisions used in Table 4.1 of C/AS1, and the firecell floor areas are reverse engineered by using the occupant load multiplied by the appropriate occupant density. In the case of the New Zealand building it is 1 person per m^2 while for the South African C2 Museum the occupant density is 1 person per $20m^2$. The disparity in firecell area is not an error, but is an anomaly caused by the particular divisions in the scoring system.

4. FIRE SAFETY FEATURES

4.1. FIRE SAFETY FEATURES

After determining the Building Use Score for the relevant buildings under comparison, the required fire safety features for each building need to be assessed. These are scored according to the system developed by McGhie [3] for each of the relevant feature headings. Under McGhie's system, 81% of the total fire safety index score is made up of the fire safety features required for the particular building.

For South African buildings the inputs for this section of the calculations are taken from the relevant sections of Part T – Fire Protection of SANS 10400 [1].

Following McGhie's lead, the inputs for the New Zealand buildings are obtained from the relevant requirements of C/AS1 [2].

4.2. FIRE BARRIERS

4.2.1. Fire Cell Rating

The inputs for South African buildings in this section of the comparison are read directly from Table 5 – Stability of Structural Elements or Components which gives the required structural stability rating in 30 minute increments. (Refer to Appendix N – SANS 10400 – Part T, Table 5: Stability of Structural Elements or Components on page 159 of this report).

The fire cell rating for New Zealand buildings are taken from the relevant sections of Table 4.1 of C/AS1 according to the occupant loading. (Refer to the relevant Tables starting with Appendix I – C/AS1 – Table 4.1: Fire Safety Precautions: (up to 100 people from page 154 of this report). The firecell rating ("F" rating) for New Zealand buildings could be 0 minutes, 30 minutes, 45 minutes, 60 minutes or 90 minutes, depending on Purpose Group, building escape height and occupant load.
In New Zealand buildings Table 4.1 allows the F rating to be F0 for single level firecells. Paragraph 6.2 also requires adjacent firecells on the same level to be fire separated to a minimum fire resistance rating of 30 minutes where the F rating is F0. As this analysis is concerned with a single firecell the requirements of Paragraph 6.2 are never invoked in the scoring analysis for single level firecells.

4.2.2. Structural Endurance Rating

For South African buildings, in this section of the comparison the inputs are taken from Table 1 – Fire Resistance of External Walls which has a requirement of either 30 minutes or 60 minutes fire resistance rating, depending on the particular building occupancy category. (Refer to Appendix O – SANS 10400 – Part T, Table 1: Fire Resistance of External Walls on page 160 of this report).

According to Part 5 – Fire Resistance Ratings [2] for New Zealand buildings the "S" rating is performed as a calculation based on the Eurocode time equivalent (t_e) for complete burnout of the firecell. This calculation takes into account the floor area, areas of vertical (A_v) and horizontal (A_h) openings or vents and the relevant fire load or fire hazard category (FHC). McGhie arbitrarily used an "S" rating of twice the assigned "F" rating. Although this appears to have been done to achieve an element of consistency across the rankings which were carried out, this author is of the opinion that in practice designers typically try to bring the required "S" rating down as low as possible by increasing available permitted ventilation areas. This typically results in "S" ratings which are substantially lower than twice the "F" rating. For the purposes of this report and consistency, the "S" rating will be kept at twice the "F" rating.

As this feature does not necessarily enhance the level of life safety of the building occupants consideration was given to possibly eliminating this feature from the scoring analysis. This was, however, rejected, as to remove a feature from McGhie's Fire Safety Index system would have entailed re-working the weighting system which was clearly beyond the scope of this report.

4.3. Fire Alarm

For South African buildings the requirements for fire alarm systems are decided according to the requirements stated in section TT31 of SANS 10400 [1], depending on the particular building occupancy category. (Refer to Appendix P – SANS 10400 – Part T, Section TT 31: Fire Detection and Alarm Systems on page 161 of this report). Any fire detection and alarm system is required to be installed in accordance with the requirements of SABS 0139 [19]. There are no permissible trade-offs in travel distances when automatic fire detection and alarm systems are installed.

The requirements for fire alarm systems (Type 1 to Type 7) in New Zealand buildings are taken from the relevant part of Table 4.1 of C/AS1[2]. For New Zealand building, the typical fire alarm Types applicable to this section are: Type 1 – Domestic smoke alarms; Type 2 – Manual fire alarm call points; Type 3 – Heat detection and manual call points; Type 4 – Smoke detection and manual call points; Type 5 – Modified smoke/heat detection and manual call points.

The installation of an automatic fire alarm system (smoke or heat detection) allows trade-offs in increased permissible travel distances per section 3.5 and Table 3.3 of C/AS1, where the installation of a smoke detection system typically allows an increase of 100% in permitted travel distances and the provision of a heat detection system permits a 20% increase in maximum permitted travel distances for non-sleeping occupancies. Where the building has sleeping type occupancies, the permitted increases are 50% and 10% for smoke detection and heat detection respectively. (Refer to Appendix Q – C/AS1 – Table 3.3: Lengths of Open Paths and Protected Paths on page 162 of this report). The effect of this is an increase in the scoring for the provision of the alarm system, but a commensurate decrease in scoring due to increased travel distances. These permitted trade-offs effectively mean that the level of safety in New Zealand buildings remain fairly consistent throughout the occupancy classification. As these are active systems, a high reliance is placed on correct and proper maintenance of fire alarm systems.
For the analysis on attached residential apartments SR purpose group Table 4.1/5 of C/AS1 calls for the installation of Type 1 domestic smoke alarms. However McGhie's Fire Safety Index system does not include Type 1 alarms in the analysis. To include Type 1 alarms in the analysis would have entailed re-working McGhie's Fire Safety Index system which was beyond the scope of the project. It is acknowledged that the provision of smoke alarms would increase the level of safety for this type of building. If the Type 1 alarms had been scored as Type 4 smoke detectors (Attribute score 5 x weighting 0.1176) would have allowed the permissible trade-offs in 50% increased travel distances, which, as is shown in the other purpose groups where this was done, generally has no net change in score.

For the SA purpose group the Type 5 alarm is included in all buildings two storeys and higher. The only buildings where the Type 5 was not used is the single level buildings as Table 4.1/5 calls for a Type 5af which means an alarm is "not required where: the escape

routes are for purpose group SA and serve no more than 10 beds ... or exit doors from purpose group SA and SR firecells open directly onto a safe place or an external safe path".

4.4. SMOKE CONTROL

4.4.1. HVAC Control

For South African buildings the requirements for control of fire spread via air-conditioning and ventilation systems is contained in section TT43 of SANS 10400 [1], which requires that in the event of fire the spread and distribution of products of combustion by air-conditioning or ventilation system is prevented.

The requirements for smoke control systems (Type 9) in air handling systems for New Zealand buildings are taken from the relevant part of Table 4.1[2]. The smoke control in air handling systems are a means of shutting down the heating, ventilation or air-conditioning systems in a building by means of an output from a fire alarm panel or a self-contained detection and control system.

During review of this report it was suggested that the requirements of Paragraph 6.23.1 of C/AS1 should also have been considered for smoke control in all buildings which Type 4 (smoke detection systems) installed. It is this author's interpretation of the provisions of C/AS1 that the requirements of Paragraph 6.23.1 are subservient to the requirements stated in Table 4.1. If the intention of the legislator was to require that all buildings with smoke detection and air conditioning / mechanical ventilation were to shut down on detection of a fire then it is expected that the Type 9 requirement would be included in every column in Table 4.1 which has a detection system requirement.

4.4.2. Smoke Extraction

In South Africa, Section TT42 of SANS 10400[1], requires that any room which has a floor area of greater than 500m^2 has a smoke control system installed. The smoke control can either be a mechanical smoke ventilation system, or a natural smoke ventilation system, being either roof ventilators or openable windows or panels. Specific requirements for the openable area of the windows, panels or roof ventilators are stated as well as requirements for the positioning (at high level) and activation of such smoke control ventilation provisions.

The activation of such systems is required to be by automatic activation by smoke or heat detectors. When such systems are manually activated they are to be capable of being opened from the floor of the room without the use of special tools.

The requirements for smoke control systems (Type 10 or Type 11) in New Zealand buildings are taken from the relevant part of Table 4.1, as well as from Part 4.2.4 of C/AS1 [2]. These systems are natural smoke venting (Type 10) by means of smoke reservoirs, outlet vents and replacement air inlets, or the provision of powered mechanical smoke extractors (Type 11).

4.4.3. Stairway Pressurisation

For South African buildings the requirements for the pressurisation of stairways in emergency routes is taken from section TT25 of SANS 10400[1], which requires that stairways in emergency routes of any building over 30 metres high shall be provided with a pressurisation system for preventing fire smoke from entering the stairway. The section also provides the details on the pressurisation requirements. The trigger for buildings classified H3 (Domestic Residence) is 50 metre building height.

The requirements for stairway or safe path pressurisation systems (Type 13) in New Zealand buildings are taken from the relevant part of Table 4.1[2]. The pressurisation systems are required to be activated by smoke detection and are required to keep safe paths free of smoke for 60 minutes to allow building occupants to reach a place of safety.

4.5. BUILDING FIRE CONTROL

4.5.1. Sprinklers

For South African buildings, the installation of automatic fire sprinkler systems in buildings is primarily a requirement of two sections of SANS 10400[1]. The first trigger for the requirement to install automatic fire sprinklers occurs in Table 3 – Maximum Division Area – of section TT4. This Table gives the maximum permissible floor area limit of firecell divisions in buildings, and has concessions for allowing larger firecell division sizes when automatic fire sprinkler systems are installed. In certain instances for certain building occupancy classes there are also maximum firecell division area limits even when automatic fire sprinkler systems are installed. (Refer to Appendix G – SANS 10400 – Part T, Table 3:

Maximum Division Area, m^2 on page 152 of this report). The effect of the firecell division floor area limitation has a proportionate effect on the total occupant number permitted, as the occupant loading is calculated as a ratio of people per m^2. This has a restricting effect on occupant numbers for South African buildings in some of the comparisons, whereby certain occupant numbers are not obtainable due to the floor area restriction.

The second driver for the requirement to install automatic fire sprinklers in buildings in certain circumstances comes through section TT 36 of SANS 10400[1]. For the purposes of this report, the relevant subsection, TT36.1(a)(i) states that "an approved sprinkler system shall be installed – in any building exceeding 30 m in height except where such building is exclusively of an occupancy classified G1 where the division size is not greater than 500 m^2, or of an occupancy classified H3" [1]. In this case, buildings over 30 m are required to have automatic fire sprinklers, although there is a concession for relatively small offices having a maximum occupant load of 33 people per storey (500 m^2 at 1 person per 15 m^2), and Domestic Residences which, by virtue of the requirements of other sections, generally have a relatively small firecell division area. (Refer to Appendix R – SANS 10400 – Part T, Section TT 36: Sprinkler Systems on page 163 of this report).

Automatic fire sprinkler installations are required to be installed in accordance with the requirements of SANS 10287:2000 – "Automatic sprinkler installations for fire-fighting purposes" [20]. Where automatic fire sprinklers are installed, they are normally installed as wet-pipe systems; therefore all South African buildings where automatic fire sprinkler systems are required will be assessed as having wet-pipe systems.

The requirements for the installation of automatic fire sprinkler systems (Type 6 or Type 7) for buildings in New Zealand are initially taken from the relevant part of Table 4.1 and the requirements of Paragraph 4.2.3 of C/AS1[2]. Sprinkler installations in New Zealand are required to be installed in accordance with the relevant standard. For commercial installations this is NZS 4541:2007 [21].

The installation of an automatic fire sprinkler system (Type 6 or Type 7) allows trade-offs in increased permissible travel distances. The installation of an automatic fire sprinkler system typically allows an increase of 100% in permitted travel distances for most purpose groups and a 50% increase for sleeping purpose groups, as per section 3.5 and Table 3.3 of C/AS1.

(Refer to Appendix Q – C/AS1 – Table 3.3: Lengths of Open Paths and Protected Paths on page 162 of this report).

A large dependence is placed on system reliability and the correct and proper maintenance of the automatic fire sprinkler systems. Koffel [22] lists the reliability of success of automatic fire sprinkler systems as ranging between 81.3% to 99.5%. These results appear to be the summary of other research documents and are mainly from United States data, with some inputs from Canadian and United Kingdom studies. Koffel's study also includes the results of Marryatt's study of sprinkler system reliability in Australia and New Zealand [23] which has the highest reported system reliability at 99.5%. Koffel's March 2004 results have been updated in his 2005 report and comfortably give a reliability of 91%. The results of Marryatt's study for Australia and New Zealand have stated that the reliability of automatic fire sprinkler systems is 99.5%. This is assumed to be due to the high standards required for system checking and maintenance in these two countries.

4.5.2. Sprinkler Water Supply

In buildings in South Africa the provision of an acceptable water supply to any automatic fire sprinkler system is governed by the requirements of the sprinkler standard [20]. For South African automatic fire sprinkler installations two approved water supplies are required. The water supply is usually towns' mains and secondary water tanks and pumps. This is the equivalent of the New Zealand Class A dual superior supply.

In New Zealand, automatic fire sprinkler systems are required to be installed to the relevant Standard. In most instances, the relevant standard is NZ4541 and the most recent current version is NZS4541:2007 [21]. The supply of water to approved automatic fire sprinkler systems is generally by means of Class C1 – Single Supply systems. For the purposes of this report, all buildings in New Zealand, where automatic fire sprinkler systems are required are assessed as having a single approved water supply.

This author has noticed of late that compliance assessments of some single-supply sprinkler protected buildings have revealed that some buildings no longer meet the specified design flow and pressure requirements. This appears to have occurred in areas where increased demand on supply mains or a reduction in supply pressure by the water authority has had an

adverse effect on available water supply. The issue of water supply also appears to have been an issue of some concern for the Standards Committee tasked with the preparation of NZS 4541:2007 – Automatic Sprinkler Systems, as there is specific comment in this regard in the Forward to the Standard, which states [21]:

"The Sprinkler Standards Committee is aware that some water supplies approved in the past, may not now comply with the requirements for an "approved" supply under NZS 4541. There are a number of reasons why this deteriorating situation is occurring, such as:

(a) Water conservation measures which may include the installation of pressure reduction valves in public water mains, or shut down of water pumps during periods of low draw-off, for example during the early hours of the morning;
(b) Increased demand/draw-off from public water supplies;
(c) Ageing reticulations;
(d) Deteriorating reliability."

Further investigation into this aspect is beyond the scope of this project, but may be an area to be considered for further research.

4.5.3. Occupant Fire Fighting Equipment

For South African buildings the requirements for occupant fire fighting equipment is stipulated in sections TT 37 – Portable Fire Extinguishers and TT 34 – Hose Reels of SANS 10400 [1]. The requirement for portable fire extinguishers is summarised in Table 10 – Provision of Portable Extinguishers of section TT 37. This table states the requirement for the number of fire extinguishers which shall be provided relative to the floor area. The size and type of fire extinguishers required is stated in section TT 37.5 (Refer to Appendix S – SANS 10400 – Part T, Section TT 37: Portable Fire Extinguishers on page 164 of this report). Section TT 34 requires the installation of fire hose reels "in any building of two or more storeys in height or in any single storey building of more than 250 m^2 in floor area".[1]. The installation of fire hose reels is not required in buildings classified H4. Fire hose reels are also not required in buildings classified H3 where the dwelling unit has separate and independent access to Ground level.

The requirements for occupant fire fighting equipment in New Zealand buildings is stated as a Type 14 fire safety precaution and is installed in the building as required by the relevant

part of Table 4.1[2]. This type of occupant fire fighting equipment is fire-hose reels for use by the NZFS and trained building occupants. These are not commonplace in New Zealand, only being required in a select few occupancies.

4.6. EMERGENCY POWER SUPPLY

The requirements for emergency power supply is only stipulated in section TT47.3 of SANS 10400[1], which requires that emergency power be supplied to any firemen's lift. A firemen's lift is required in buildings exceeding 30 m in height.

The requirements for Emergency electrical power supply for New Zealand buildings is listed as a Type 17 fire safety precaution and is installed in the building as required by the relevant part of Table 4.1[2]. Emergency electrical power supply is generally only for tall buildings with crowd or sleeping occupancies.

4.7. COMMUNICATION SYSTEM

In South Africa the requirements for the provision of fire communications systems stems primarily from the provisions of section TT47 of SANS 10400[1], which requires that an oral communication system be provided between a firemen's lift and a control point or control room.

The requirements for a voice communication system (Type 8 and Type 20) for buildings in New Zealand is taken from the relevant part of Table 4.1[2]. A Type 8 system allows voice messages to be delivered and has the ability to allow two-way communication with fire-fighters. The Type 20 system is a facility installed in a building allowing fire-fighters to control building services and communicate from a central control point.
Although not strictly a requirement of the Building Code, New Zealand buildings generally require the implementation of an evacuation scheme or plan in terms of the Fire Safety and Evacuation of Building Regulations[24], the New Zealand buildings are therefore accordingly awarded points for having an evacuation plan and fire wardens.

4.8. FIRE SERVICE

4.8.1. Alerting

There are no stated requirements SANS 10400[1] for South African buildings to have any form of direct link to the fire service or other monitoring company, although in practice many South African buildings are monitored by an alarm monitoring company which would relay fire alarm signals to the local fire department. South African buildings are therefore only awarded a score for telephone communication.

In New Zealand buildings which are required by the relevant part of Table 4.1[2] to have a fire alarm system installed are also required to have a direct connection to the Fire Service. Table 4.1[2] does allow for certain instances when a direct connection is not required (as indicated by the letter "f"), as long as a telephone is installed and available for immediate use.

4.8.2. Lift Control

The requirements for firemen's lift control in South African buildings is found in section TT47 of SANS 10400[1], which requires that a firemen's lift (and lift controls) be installed in buildings exceeding 30 m in height.

For New Zealand buildings the requirements for Fire Service lift control in buildings is listed as a Type 15 fire safety precaution and is installed in the building as required by the relevant part of Table 4.1[2]. This system allows the NZFS to have exclusive control of lifts for fire-fighting purposes.

4.8.3. Fire Fighting Access (Fire Hydrant System)

For South African buildings, the requirements for the installation of fire hydrants in and around buildings is stipulated in section TT35 of SANS 10400[1], which requires that fire hydrants be installed for certain buildings. The buildings which require fire hydrants to be installed are:

- All buildings over 12 m in height,
- Buildings of any height where the total floor area exceeds 1000m^2 in the following occupancy classes:

- B1 High Risk Commercial Service
- B2 Moderate Risk Commercial Service
- C1 Exhibition Hall
- C2 Museum
- D1 High Risk Industrial
- D2 Moderate Risk Industrial
- E1 Place of Detention
- E2 Hospital
- E3 Other Institutional (Residential)
- F1 Large Shop
- F3 Wholesalers Store
- H1 Hotel
- J1 High Risk Storage
- J2 Moderate Risk Storage
- J3 Low Risk Storage
- J4 Parking Garage

– Shopping Centres, Group Housing, Cluster Housing, Town House Complexes, Exhibition Grounds or Permanent Amusement Parks shall also have hydrants installed so that no part of any building is further than 90 m from a fire hydrant.

For New Zealand buildings the requirements for the provision of fire hydrants for buildings is listed as a Type 18 fire safety precaution and is required by the relevant part of Table 4.1[2]. All buildings are required to have a fire hydrant system, but this is mostly negated by the suffix "c" to the Type 18, which only requires the installation of a fire hydrant where the hose run distance from the fire service vehicular access point to any point on any floor exceeds 75m. With careful planning most single and two-storey buildings will not required the installation of any fire hydrant system.

4.9. MEANS OF ESCAPE

4.9.1. Number of Escape Routes

For South African buildings the provision of escape routes comes under Section TT16 of SANS 10400[1] which states that "One or more escape routes shall be provided in any building". The generally accepted interpretation of this concept is that at least one escape

route is required and is not considered to be the common entry point to the building, subject to the dead-end travel distance being complied with. The number of escape routes required is also a factor of the occupant load, in that TT21 also states that no individual escape route is permitted to serve more than 190 people.

The requirements for the minimum number of escape routes required for buildings in New Zealand is found in Paragraph 3.2 and Table 3.1 of C/AS1 [2]. (Refer to Appendix T – C/AS1 – Table 3.1: Number of Escape Routes from a Floor Level on page 165 of this report).
In New Zealand, certain buildings are permitted in terms of Paragraph 3.15 to have single escape routes subject to meeting strict conditions relating to building height, occupant loads, fire hazard category and occupancy classes.
It is brought to the reader's attention that in certain buildings it is possible to have a building with less than 50 occupants with a single means of escape and still apply all permissible travel distance increases allowed whenever the various fire alarm systems are provided (As discussed in later sections).

4.9.2. Width of Escape Routes

The required widths of components of escape routes for South African buildings is found in section TT 21 and Table 9 of SANS 10400[1]. The deemed-to-satisfy document notably does not permit any individual escape route to cater for more than 190 people. This in turn influences the number of escape routes that are required to be provided within a building, based on the calculated occupant load.
Although not explicitly stated, the required width for escape routes in South Africa is 9 mm per person for both horizontal and vertical components. This is deduced from Table 9 which states a minimum required width for a maximum permissible number of people. The ranges in the Table are from 1100 mm for 120 people to 1800 mm for 190 people. This works out at between 9.16 mm per person to 9.47 mm per person. There is no differentiated escape route width for horizontal or vertical travel paths. Both are required to have the same width factor.
As is the case in Paragraph 3.3.2.g of C/AS1[2], only the occupant load of the floor with the highest occupant load is required for the calculation of the width of vertical escape routes (stairs). Section TT 21.2 also contains the requirement for discounting one escape route when calculating the required widths of escape routes. There is no trade-off for allowing all escape

routes to be used in sprinkler protected buildings. (Refer to Appendix U – SANS 10400 – Part T, Section TT 21 & Table 9: Width of Escape Routes on page 166 of this report).

The requirements for the width of escape routes for New Zealand buildings is determined by Paragraph 3.3.2 and Table 3.2 of C/AS1[2]. For most indoor purpose groups the base calculation factor for escape route widths is 7 mm per person for horizontal escape route components and 9 mm per person for vertical escape routes (stairways). Sleeping purpose groups require 8 mm and 10 mm respectively per person. Where automatic fire sprinkler systems are installed there is a trade-off allowed which permits all escape routes to be available for use i.e. there is no need to discount one escape route when calculating the required width for escape routes. (Refer to Appendix V – C/AS1 – Table 3.2: Width of Escape Routes on page 167 of this report).

4.9.3. Emergency Lighting

In the South African Deemed-to-Satisfy document SANS 10400, section TT30 the primary trigger for the provision of emergency lighting in Emergency Routes is the total building design occupant load. As soon as the total building design occupant load exceeds 100 people, emergency lighting sources are required to be installed in Emergency Routes of buildings.
In addition to the requirement for emergency lighting in Emergency Routes, buildings with certain Occupancy or Building Classifications are required to also have emergency lighting in the feeder routes (regardless of whether Emergency Routes are required or not).
The following Building or Occupancy Classifications are required to be provided with emergency lighting in the feeder routes:

A1 Entertainment and Public Assembly
A2 Theatrical and Indoor Sport
A3 Places of Instruction
A4 Worship
C1 Exhibition Hall
C2 Museum
E2 Hospital
E3 Other Institutional (Residential)
F1 Large Shop
F3 Wholesalers Store

In the case of an occupancy classified as A3 with an occupant load of less than 50 people, there is no requirement to provide emergency lighting in the feeder routes.

In New Zealand buildings the requirements for the provision of emergency lighting in buildings is stated as a Type 16 fire safety precaution in the relevant part of Table 4.1[2]. The November 2008 amendments to C/AS1 changed the Type 16 fire safety precaution from "Emergency Lighting in Exitways" to "Visibility in Escape Routes". This change effectively increased the requirement from a situation where some form of emergency lighting was only required in Exitways (as strictly defined) to cover a far broader range of buildings and now requires the installation of emergency lighting in a far wider range of buildings than was previously the case. Lighting for emergency is to comply with Clause F6 of the New Zealand Building Code which essentially requires emergency lighting to be installed whenever the distance of travel to the closest final exit exceeds 20 m, in exitways, at any change of level or any change of direction.

4.9.4. Refuge Areas

In the South African context there is no requirement for the provision of refuge areas or any similar concept within the Deemed-to-Satisfy document, SANS 10400. South African buildings will therefore not score any points in this category.

The requirement for the provision of refuge areas for New Zealand buildings is stated as a Type 19 fire safety precaution in part of Table 4.1[2]. Refuge areas are required for certain tall buildings within the safe path stairs, to ease congestion and to allow places where faster moving persons can pass slower moving people.

4.9.5. Dead End Open Path Length (DEOP)

The maximum permissible dead-end travel distance in any building in South Africa is a requirement of section TT16.4 (e) of SANS 10400 [1], which states

"the exist (sic) door from any room shall lead directly into a feeder route: Provided that –

i. such exist (sic) door may lead into a dead-end corridor where the total distance to be travelled from the furthest point in such room to an access door or to a feeder route is not more than 15m;"

There are no trade-offs available in terms of increased permissible dead-end travel distance when any type of automatic fire alarm system (heat or smoke detectors) or automatic fire sprinkler system is installed. The dead-end travel distance is the same for all buildings and occupancy classifications.

The maximum permissible dead-end travel distance for buildings in New Zealand is addressed in Paragraph 3.4 and Table 3.3[2], with the permissible increase in lengths allowed by Paragraph 3.5. In most purpose groups, the installation of heat detectors allows a 20% increase in permitted dead-end travel distance, smoke detectors allow a 100% increase and the installation of sprinklers also permit a 100% increase in permissible dead-end travel distance. For sleeping purpose groups SA, SR and SH the permitted increases are: 50% where smoke detectors or sprinklers are installed and 10% where heat detectors are installed. (Refer to Appendix Q – C/AS1 – Table 3.3: Lengths of Open Paths and Protected Paths on page 162 of this report). Paragraph 3.5.6 of C/AS1 also makes allowance for permitted increases in travel distance to be added onto each other and can result in travel distances up to 3 (three) times longer than the distance stipulated in Table 3.3 in certain instances in large spaces. When the installation of an automatic fire alarm system (smoke or heat detection) or an automatic fire sprinkler system results in a permitted trade-off by virtue of increased permissible travel distances, the effect of the increased travel distances is a decrease in the attribute score for travel distances.

4.9.6. Total Open Path Lengths (TOP)

For South African buildings, in terms of section TT16.2 and TT16.3 and TT16.4 of SANS 10400[1], the maximum permissible open path travel distance in a building in South Africa is required to be less than 45 metres. Whenever the travel distance exceeds the 45 metre limit, buildings are required to provide an Emergency Route for use by building occupants. The emergency route has essentially the same requirement for protection from fire as would be found in a Safe Path (NZ). An example of this is TT16.3 which states: “Where, in any building, the travel distance measured to the nearest escape door is more than 45 m, not less than two such escape routes shall be provided and an emergency route shall form part of each such escape route” [1].

As is the case with dead-end travel distance requirements, there are no trade-offs available in terms of increased permissible open path distance when any type of automatic fire alarm system (heat or smoke detectors) or automatic fire sprinkler system is installed. The open path travel distance requirement is the same for all buildings and occupancy classifications.

The maximum permissible total open path travel distance for buildings in New Zealand is stated in Paragraph 3.4 and Table 3.3[2], subject to the allowable increase in lengths permitted by Paragraph 3.5. In most purpose groups, the installation of heat detectors, smoke detectors or sprinklers result in an increase to the permissible open path travel distance. The percentage increase permitted is the same as for the dead-end open path cases. (Refer to Appendix Q – C/AS1 – Table 3.3: Lengths of Open Paths and Protected Paths on page 162 of this report). The same summation of increases for dead-end open paths applies mutatis mutandis. The effect of the trade-offs permitted is a reduction in the attribute score for travel distances for that building.

4.9.7. Protected Paths

In the South African Deemed-to-Satisfy document, SANS 10400[1], there is no provision or concept for any form of Protected Path. The egress flow from a room in a building goes from the room, via the exit door along a dead end corridor into a feeder route and then into an emergency route. There is therefore no similar or comparable component to the Protected Path in South Africa.

The New Zealand approved document C/AS1[2] has a requirement for protected paths to be provided in certain circumstances. Where required, these are to be provided as a transition between open paths and safe paths. The maximum permitted protected path length is listed in Table 3.3 (Refer to Appendix Q – C/AS1 – Table 3.3: Lengths of Open Paths and Protected Paths on page 162 of this report). Protected paths vary in length from a maximum of 30 metres to a maximum of 90 metres, depending on the occupancy classification. There are no permitted increases in the length of a protected path under any circumstances. It is noted that in practice Protected Paths are rarely used in New Zealand buildings, but because they are included in C/AS1 they are scored accordingly wherever they are permitted in buildings.

A dilemma arose with regard to this component of McGhie's ranking and weighting of the Protected Path element of the scoring for the Fire Safety Feature element "Protected Path". Should South African buildings receive an Attribute Score of zero for the range of the Protected Path length exceeding 90 metres? Or would it be more appropriate to give South African buildings an Attribute Score of 5 for an assumed Protected Path length of less than 30 metres? An important point which was considered during the search for an appropriate Attribute Score to use is that SANS 10400 only permits a maximum open path travel distance of 45 metres before a person is required to be within an Emergency Route. After some consideration and deliberation, it was decided to use an Attribute Score of 4 for South African buildings primarily for the following reason: the "Protected Path Length" Attribute Score of 4 has a range from 30 metres to less than or equal to 45 metres; and at 45 metres a person escaping from a fire in a South African building would have to transition from an open path into a fire separated Emergency Route (which has similar features to the New Zealand Safe Path), therefore the so-called protected path length Attribute Score which will be used for South African buildings in all cases will be 45m.

Consideration was also given to possibly eliminating this feature from the scoring analysis. This was, however, rejected, as to remove a feature from McGhie's Fire Safety Index system would have entailed re-working the weighting system which was clearly beyond the scope of this report.

4.9.8. Surface Finishes Exitways

In the South African context it should be borne in mind that exitways are referred to as Emergency Routes. The requirements for the classification of the surface finishes in South Africa are covered sections TT13 (Ceilings), TT14 (Floor Coverings) and TT15 (Wall Finishes) of SANS 10400. These sections in turn have the specific indices required listed under Table 7 – Required Classifications for Fitted Floor Coverings and Table 8 – Required Classifications for Wall Finishes. These Tables list the required classification on a scale ranging from Non-combustible to 5, where the lower the number the more stringent the requirement, with non-combustible equivalent to a zero Attribute Score. (Refer to Appendix W – SANS 10400 – Part T, Table 7: Required Classifications for Fitted Floor Coverings on page 168 and Appendix X – SANS 10400 – Part T, Table 8: Required Classifications for Wall Finishes on page 169 of this report). In the context of the Attribute Score for this

comparison, the ranking is as shown in Table 3 – Application of Attribute Score for Surface Finishes.

Attribute Score	Classification of Surface Finish (SANS 10400)
0	5
1	4
2	3
3	2
4	1
5	Non-combustible

Table 3 – Application of Attribute Score for Surface Finishes

As the requirements for surface finishes are set out in two separate tables and three different sections within SANS 10400, only the relevant classification for wall finishes are assessed in this comparison using the Attribute Score as indicated in Table 3. It is the opinion of this author that the use of the classifications for wall surfaces only gives a broad brush approximation of the relevant requirements for all three components, namely floors, walls and ceilings. The actual comparisons of each of the relevant areas of the surface finish requirements for equivalencies are sufficiently complex as to warrant a separate research project. Any further in depth investigation of this area is beyond the scope of this report.

In New Zealand buildings the requirements for Interior Surface Finishes and Suspended Flexible Fabrics within Exitways appears in various paragraphs in Part 6 and Table 6.2 of C/AS1 [2]. (Refer to Appendix Y – C/AS1 – Table 6.2: Requirements for Interior Surface Finishes and Suspended Flexible Fabrics to Inhibit Fire Spread on page 170 of this report). These are similar to the requirements for surface finishes in other occupied spaces, but with more stringent requirements.

4.9.9. Surface Finishes Occupied Spaces

The requirements for the control of spread of flame across surfaces in occupied spaces in South African buildings uses the same methodology, sections and tables as for the

requirements for surface finishes within exitways. The equivalent Attribute Scores are also those as listed in Table 3. Again, only the indices for wall finishes are used within this comparison. For the surface finishes of occupied spaces there are trade-offs permitted with reduced requirements when firecells are sprinkler protected.

For New Zealand buildings the requirements for Interior Surface Finishes and Suspended Flexible Fabrics within occupied spaces appears in various paragraphs in Part 6 and Table 6.2 of C/AS1 [2]. (Refer to Appendix Y – C/AS1 – Table 6.2: Requirements for Interior Surface Finishes and Suspended Flexible Fabrics to Inhibit Fire Spread on page 170 of this report). As stated by McGhie [3], certain areas such as classrooms in certain circumstances can have reduced requirements for the indices for surface finishes. This report has continued with McGhie's custom of ignoring these as they are relatively insignificant in the scope of this project.

4.9.10. Signage

Requirements for signage in South African buildings is contained in section TT 29 "Markings and Signposting" in the South African Deemed-to-Satisfy document, SANS 10400, [1]. All fire exits and escape routes are required to be adequately signposted. In addition, TT 29.3 requires that signage be illuminated. In the case of buildings with an occupancy classification of A2, E1, E2 and E3, as well as "any building normally occupied during the hours of darkness and having a population exceeding 100 persons" [1] such signage is also required to have an emergency power supply to enable such signs to continue to be visible for at least 120 minutes. In the context of this comparison, all South African buildings will attain an Attribute Score of 1 for Fire Exit Signs and where buildings fall within the criteria for the provision of emergency power to the sign illumination then the Attribute Score will be given as 3 for Illuminated Exit Signs.

The requirement for signs in New Zealand buildings is stated under Paragraph 3.20 of C/AS1 [2]. Signs are required in escape routes and on fire and smoke control doors in all buildings except within household units. Continuing with McGhie's custom [3], the comparison will again assume that when emergency lighting has been installed then exit signs will also be illuminated.

4.10. RELATIVE IMPORTANCE OF FIRE SAFETY FEATURES

According to McGhie's risk ranking System [3], the different types of available fire safety features installed in a building have been assessed and a relative weighting has been applied to each feature. This system allows for 81% of the total fire safety index score to be allocated for the Fire Safety Features Score for each particular building.

For every point change in the Attribute Score for a fire safety feature in a building, the effect on the total score is an increase or decrease equivalent to the value of the weighting. Thus, when, for example a sprinkler system is installed in a building the addition to the total is either 4 or 5 times the weighting (0.0713) for either a wet or dry pipe system. In addition a sprinkler system must have a water supply and this also adds to the total fire safety features score. The relevant weightings of the scoring system can be arranged in order of importance, by virtue of the value of the weight attached to a fire safety feature. By arranging the features in order of the weight attached to the feature it soon becomes apparent which features are expected to have the greatest impact on the total fire safety index score for a particular building as mandatory features are added to the mix, or when trade-offs reduce the attribute score.

The values of the attribute score for each feature has been arranged in order of numerical value accorded each feature by McGhie, and is shown in Table 4 – Fire Safety Features – Order of Weighting.

		Weighting
	Building Use	
BU2	BU2 - Building Escape Height	0.0663
BU4	BU4 - Fire Hazard Category	0.0663
BU1	BU1 - Purpose Group	0.0332
BU3	BU3 - Occupant Numbers	0.0221
	Total Building Use Score (BUS)	**0.1879**
	Fire Safety Features	
A1	Firecell Rating	0.1504
B	Fire Alarm Type	0.1176
A2	Structural Rating	0.0962
D1	Sprinkler System	0.0713
H9	Occupied Spaces Surface Finish	0.0454
C1	HVAC Control	0.0368
H7	Protected Path (PP)	0.0272
G1	Alerting	0.0266
G3	Fire Fighting Access	0.0221
C2	Smoke Extraction	0.0201
C3	Stairwell Pressurisation	0.0201
H5	Dead End Open Path (DEOP)	0.0199
H6	Total Open Path (TOP)	0.0199
H1	No of Escape Routes	0.0196
H2	Width of Escape Routes	0.0196
F	Communication System	0.0195
D2	Water Supply	0.0190
E	Emergency Power Supply	0.0158
G2	Firemen's Lift control	0.0157
H8	Exitway Surface Finishes	0.0112
H3	Emergency Lighting	0.0051
H10	Signage	0.0051
D3	Occupant Fire Fighting	0.0048
H4	Refuge Areas	0.0026
	Total Fire Safety Features (FSF)	**0.8116**
	Fire Safety Index	**1.00**

Table 4 – Fire Safety Features – Order of Weighting

The tabulation of the order of importance of the weighting for the various fire safety features is shown graphically in Figure 3 – Fire Safety Feature Weighting Importance.

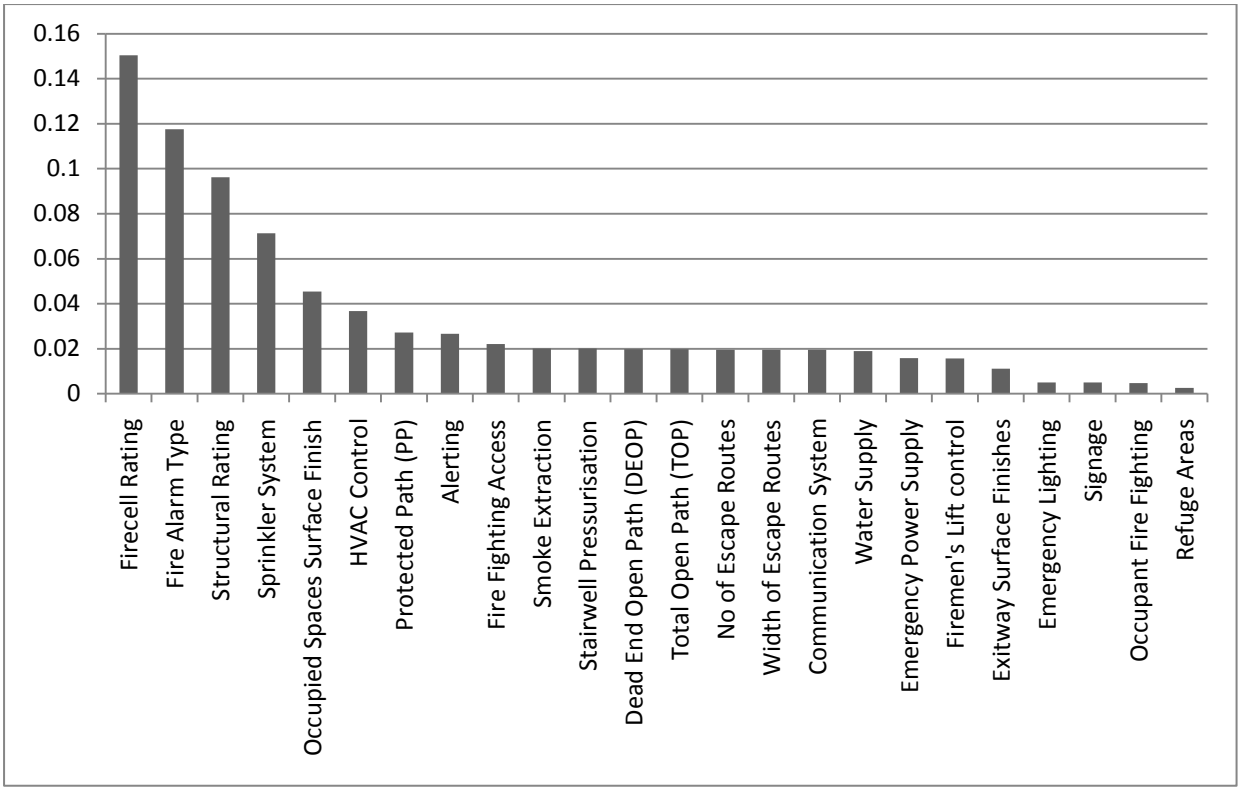

Figure 3 – Fire Safety Feature Weighting Importance

5. WORK TYPE OCCUPANCIES (LOW FIRE HAZARD CATEGORY WL 2)

5.1. General

These occupancies are generally regarded as "Awake and Aware" type premises. The majority of occupants are usually involved in some type of working situation or work or business related activity. The building occupants are generally assumed to be fully awake; the occupants are not normally expected to be under the influence of alcohol, medication or other drugs. The occupants are assumed to have a reasonable level of comprehension and understanding. The occupants can follow instruction and are often in a structured environment with supervision. In many working type environments, such as factories, the presence of people with physical and/or intellectual disabilities is limited by the type of work involved. It is worth noting that while legislation bars discrimination on the grounds of disability (or special needs) many occupations in the workplace require full mobility and functioning purely by the nature of the work. Nothing in this report should be taken to infer that any form of discrimination is being promoted, encouraged or acquiesced to. Where people with disabilities are, however, present their ratio or number is likely to be low.

Working environments also have additional statutory provisions in place governing employment, such as health and safety in employment laws and regulations. In some instances regulations governing hazardous substances and materials may impose additional safeguards in relation to fire safety. In New Zealand the Fire Safety and Evacuation of Buildings Regulations [24] also impose additional measures and impose a duty to ensure that regular building evacuation drills are carried out in terms of approved evacuation schemes or procedures.

While these matters may actually increase the level of fire safety in working type buildings, they are considered to be in addition to the inherent levels of safety provided by virtue of the building construction and fire safety precautions installed in buildings, therefore such matters are not considered within the measurement of the Fire Safety Index.

5.2. Purpose Groups and Fire Hazard Categories

The purpose group for working/business type occupancies in this section of the comparison is WL (Working Light) and the Fire Hazard Category is 2. From the breakdown of the occupancy or building classifications applicable to this section from SANS 10400 the

following classes of occupancy are compared to the C/AS1 WL 2 purpose groups as shown in Table 5 – Working / Business Occupancies.

New Zealand	South Africa
WL 2	B3 – Low Risk Commercial Service
WL 2	D3 – Low Risk Industrial
WL 2	J3 – Low Risk Storage
WL 2	G1 – Offices

Table 5 – Working / Business Occupancies

5.3. Firecell Size – Maximum Division Area

For South African buildings the maximum division area size of a firecell is restricted by Table 3 of Part T of SANS 10400. (Refer to Appendix G – SANS 10400 – Part T, Table 3: Maximum Division Area, m^2 on page 152 of this report). For working type purpose groups B3 (Low Risk Commercial) and G1 (Offices) the firecell division floor area limit is 5000 m^2 where no fixed automatic fire extinguishment system (typically sprinklers) is installed. Where a fixed automatic fire extinguishment system (sprinklers) is installed in a single storey building the fire cell division size is unlimited, and in buildings two storeys and over the fire cell division size is restricted to a maximum area of 10000 m^2. For the other working type purpose group D3 (Low Risk Industrial) the firecell division floor area limit is 2500 m^2 where no fixed automatic fire extinguishment system (sprinklers) is installed. In a single storey building with fixed automatic fire extinguishment system (sprinklers) the fire cell division size is unlimited and for buildings two storeys and over the fire cell division size is restricted to a maximum area of 5000 m^2.

In New Zealand, the occupant loading of some of the scoring for this section triggers the requirement for sprinklers to be installed for example when using an occupant density of 0.1 persons/m^2 for the working purpose group WL 2, the occupant load of 500 people (and above) means that the area of the firecell goes above the limit of 2500m^2 for Fire Hazard Category 2 buildings. As the floor area for this type of working occupancy then is calculated to be 5000m^2 it therefore becomes necessary by default to install automatic fire extinguishing systems such as sprinklers for this section of the scoring, even though it is not a requirement

of Table 4.1. (Refer to Appendix K – C/AS1 – Table 4.1/3: Fire Safety Precautions: (501 to 1000 people) on page 156 of this report).

5.4. Fire Safety Index Results

The Fire Safety Index for each building in the Working Purpose Group Occupancies is calculated using spreadsheets which are attached as Appendices. These start with Appendix Z – Fire Safety Index Calculations – PG: WL (0m, ≤ 50 occupants on page 171 and continue through to Appendix AI – Fire Safety Index Calculations – PG: WL (≤ 4m, ≤ 1200 occupants. Fire Safety Index scores for the other building heights have been calculated on separate spreadsheets which are not included in the appendices. The combined results of the fire safety index calculations for this purpose group are shown in Table 6 – Fire Safety Index: Working Purpose Groups.

Height	**Building Classification**	**Occupant Number**				
		< 50	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**
0 m	**C/AS1: WL 2**	1.60	1.83	1.73	2.70	2.53
	SANS 10400: B3	1.89	1.86	3.07	2.98	2.96
	SANS 10400: D3	1.89	1.86	3.07	2.98	2.96
	SANS 10400: J3	2.05	2.21	2.83	2.78	2.76
	SANS 10400: G1	2.01	1.99	3.07	2.98	2.96
< 4 m	**C/AS1: WL 2**	2.42	2.64	2.40	2.84	2.83
	SANS 10400: B3	2.07	2.08	3.07	2.98	2.98
	SANS 10400: D3	2.07	2.08	3.07	2.98	2.96
	SANS 10400: J3	2.28	2.29	3.28	3.28	3.25
	SANS 10400: G1	2.01	2.02	3.07	2.98	2.98
4 m to 10 m	**C/AS1: WL 2**	2.84	2.82	2.50	2.84	3.02
	SANS 10400: B3	2.55	2.53	3.52	3.43	3.43
	SANS 10400: D3	2.40	2.38	3.37	3.28	3.26
	SANS 10400: J3	2.76	2.74	3.73	3.73	3.71
	SANS 10400: G1	2.34	2.32	3.37	3.28	3.28
10 m to	**C/AS1: WL 2**	2.80	2.88	2.54	2.85	3.03

Height	Building Classification	Occupant Number				
		< 50	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**
25 m	SANS 10400: B3	2.51	2.48	3.48	3.47	3.47
	SANS 10400: D3	2.36	2.33	3.33	3.32	3.30
	SANS 10400: J3	2.69	2.67	3.66	3.66	3.64
	SANS 10400: G1	2.30	2.27	3.33	3.32	3.32
25 m to 34 m	**C/AS1: WL 2**	2.79	2.79	2.72	3.03	3.21
	SANS 10400: B3	2.44	2.42	3.41	3.41	3.41
	SANS 10400: D3	2.29	2.27	3.26	3.26	3.24
	SANS 10400: J3	2.63	2.61	3.60	3.59	3.57
	SANS 10400: G1	2.23	2.21	3.26	3.26	3.26
34 m to 46 m	**C/AS1: WL 2**	2.91	2.90	2.84	3.15	3.14
	SANS 10400: B3	3.73	3.66	3.66	3.66	3.66
	SANS 10400: D3	3.73	3.66	3.66	3.66	3.64
	SANS 10400: J3	3.87	3.85	3.85	3.84	3.82
	SANS 10400: G1	3.22	3.60	3.66	3.66	3.66

Table 6 – Fire Safety Index: Working Purpose Groups

5.5. Fire Safety Index Comparisons (WL)

5.5.1. WL 2: Single Storey (0m)

The comparative fire safety index scores for a single level building in the WL purpose groups are shown in Figure 4 – WL 2: Single Storey (0m). The major reasons for the differences in the scoring for the various buildings in each country are discussed in the following sections.

WL 2: Single Storey, Occupant load less than 50 People

For a Single Storey Building (Escape Height 0m) in the WL 2 purpose group South African buildings have a higher fire safety index score when the occupant load is less than 50 people. This higher fire safety index score for South African buildings is attributed primarily to the Firecell rating requirement (+ 0.3008), the requirement for two escape routes (+ 0.0392) and a minimum width of 1200mm (+ 0.0196). These buildings only require a structural fire endurance of 30 minutes (+ 0.0962).

New Zealand buildings have no Firecell rating (0), only require a single escape route (0) and have an escape route width of < 1000mm (0), but the requirement for a 60 minute Structural fire endurance of 60 minutes reduces the difference in the buildings (+ 0.1924).

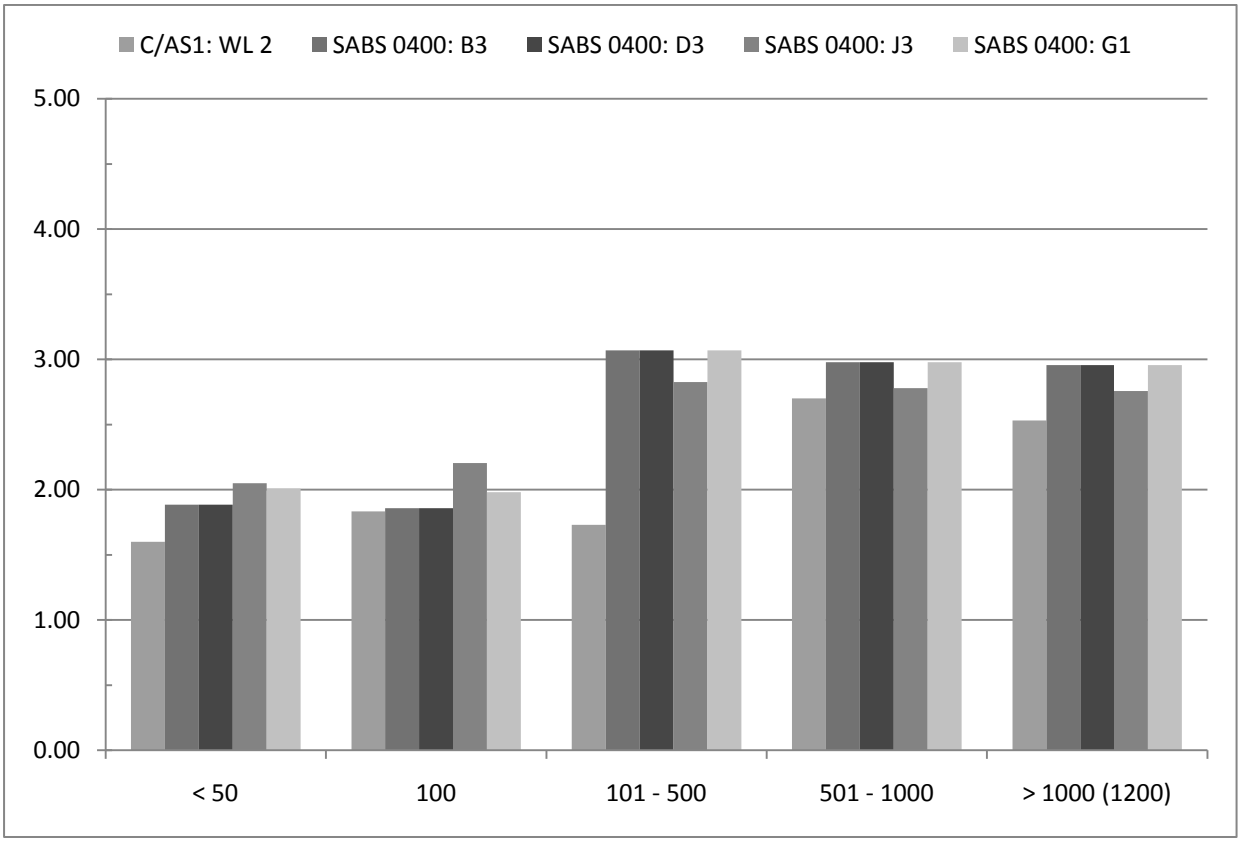

Figure 4 – WL 2: Single Storey (0m)

WL 2: Single Storey, Occupant load less than 100 People

For Single Storey Buildings with an occupant load of 100 people, there is no significant difference in the fire safety index scores for each country, and this report will not comment any further on this occupant load.

WL 2: Single Storey, Occupant load greater than 100 and up to 500 People

When the building occupant load increases into the range of above 100 people up to 500 people there is again a noticeable difference in the fire safety index scoring, with South African buildings substantially out-scoring New Zealand buildings. The main reason for this is that the occupant load has caused the floor area required to maintain that occupant load to exceed the limits which trigger the requirement for automatic fire sprinklers and an automatic

fire detection system with smoke detectors in the South African buildings under consideration. In the case of South African buildings the requirement for automatic fire sprinklers to be installed increases the score for a wet pipe sprinkler system (+ 0.3565) as well as dual superior water supply (+ 0.095). The requirement for a smoke detection system increases the score by + 0.588. There are no trade-offs permitted in terms of increased travel distances when either automatic smoke detection or automatic fire sprinklers are installed. A trade-off is, however, permitted in terms of reduced requirements for the surface finishes of occupied spaces. This is the same for New Zealand buildings and therefore there is no net difference in scoring between the buildings with regard to this requirement.

WL 2: Single Storey, Occupant load greater than 500 and up to 1000 People

As the occupant load increases to the range of 501 to 1000 occupants the South African fire safety features remains fairly constant, except for the small decrease attributed to the reduction in building use score as the occupant load increases. The increase in the total for the building fire safety index score for New Zealand buildings is primarily influenced by the upgrading from Type 2 manual fire alarm system to a Type 4 automatic fire alarm system with smoke detection and has a net increase of + 0.353. An automatic fire sprinkler system (+ 0.3565) with a single water supply (+ 0.038), a net increase (+ 0.0221) in Fire Fighting Access (Fire Hydrants) are positive contributors to the score line.

WL 2: Single Storey, Occupant load greater than 1000 People

For this occupant load category, an occupant load of 1200 people is arbitrarily taken as certain calculations are dependent on a reasonably exact occupant number. There are again minor changes in the scoring for the buildings when the occupant load exceeds 1000 people, but again they are not significantly different and no further comment will be made for this group of buildings.

5.5.2. WL 2: Double Storey (Escape Height <4m)

The comparative fire safety index scores for double storey buildings in the WL purpose groups are shown in Figure 5 – WL 2: Double Storey (< 4m). The major contributory factors to the differences in the scoring for the buildings in each country are also identified.

WL 2: Double Storey, Occupant load less than 50 People

For Double Storey Buildings (Escape Height less than 4.0m) in the WL 2 purpose group New Zealand buildings have a higher fire safety index score when the occupant load is in the category of less than 50 people. This increase in fire safety index score for New Zealand buildings is substantially due to the 60 minute Firecell rating requirement (+ 0.6016), and a net increase in the Structural fire endurance rating (+ 0.1924).

For South African buildings the only noticeable change from the single storey buildings is a + 0.184 increase as automatic shut down of HVAC systems are required. Other requirements remain substantially unchanged.

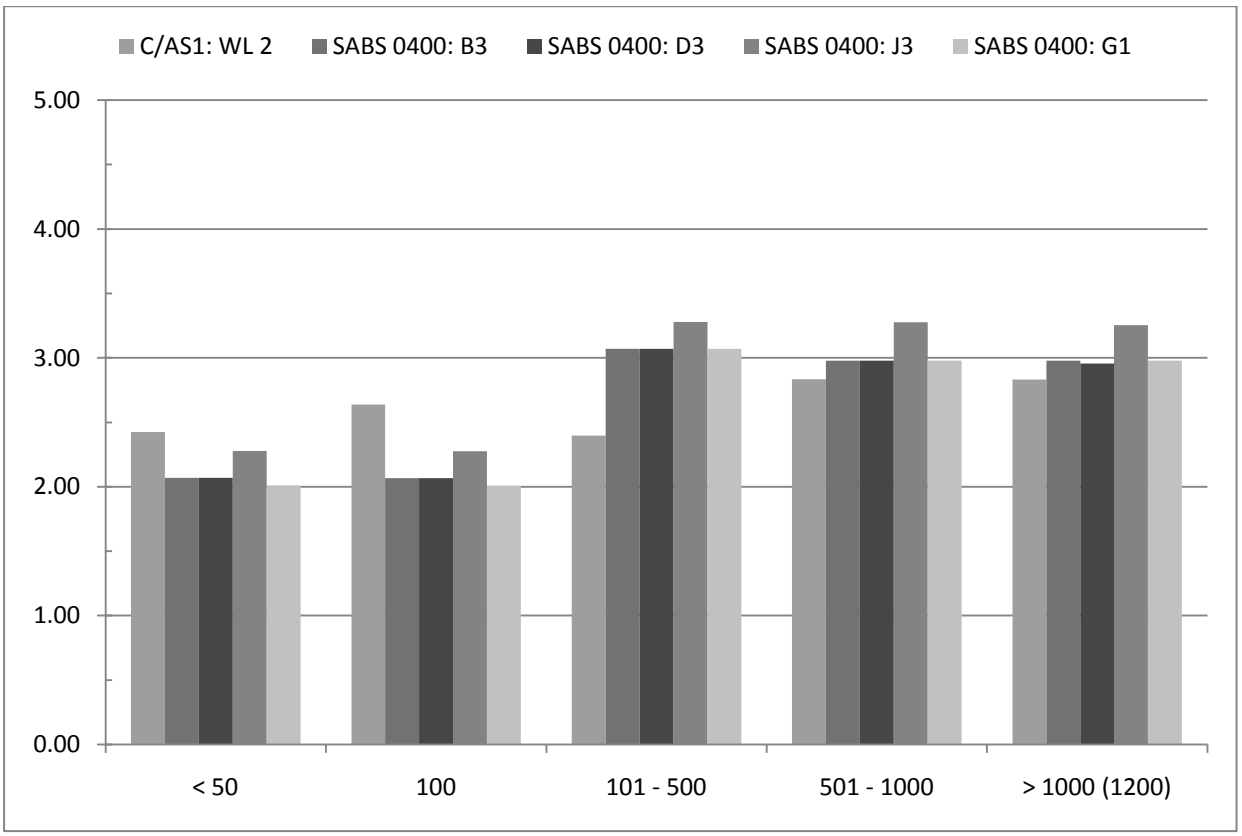

Figure 5 – WL 2: Double Storey (< 4m)

WL 2: Double Storey, (<4m) Occupant load less than 100 People

For Double Storey Buildings (escape height < 4.0m) with an occupant load of less than 100 people in the WL 2 purpose group New Zealand buildings again have a higher fire safety index score than South African buildings. This is notably because the Firecell rating for New Zealand buildings is 60 minutes while South African buildings are only 30 minutes, a difference in favour of New Zealand buildings of + 0.3008, and the increased Structural fire

endurance rating of 120 minutes resulting in a net gain for New Zealand of + 0.2886 over South African buildings.

WL 2: Double Storey, (<4m) Occupant load greater than 100 and up to 500 People

Once the occupant load of the building moves into the occupant load range of above 100 people up to 500 people the South African buildings fire safety index again out-scores New Zealand buildings. Yet again the reasons for the increase in the fire safety index scoring for South African buildings are the additional requirements for smoke detection (+ 0.588) and the requirement for automatic fire sprinklers (+ 0.3565) and water supply (+ 0.095), with the requirements for sprinklers again being brought about by the increase in floor area to support the higher occupant load, which is above the maximum floor area threshold for unsprinklered fire cells. As is the case with other South African buildings no trade-offs are permitted by virtue of increased travel distances when either automatic smoke detection or automatic fire sprinklers are installed.

Again the only trade-off allowed is for reduced requirements for the surface finishes of occupied spaces. As the same trade-off applies for New Zealand buildings there is thus no net difference in scoring for the buildings under consideration for this requirement.

WL 2: Double Storey, (<4m) Occupant load greater than 500 and up to 1000 People

Except for the small decrease attributed to the reduction in building use score as the occupant load increases South African buildings in the occupant load range from 501 occupants up to 1000 occupants the fire safety features score is constant.

The fire safety features score for New Zealand buildings has an increase mainly caused by the increase in fire alarm system from a Type 2 manual fire alarm to an automatic smoke detection system (Type 4) which results in a net increase of + 0.353.

WL 2: Double Storey, (<4m) Occupant load greater than 1000 People

As for the single storey buildings an occupant load of 1200 people is again arbitrarily used for this category. As only minor changes occur to the total fire safety index score across buildings in both countries when the building occupant load is set at 1200 people and there are no significant differences in score, this section does not warrant further comment.

5.5.3. WL 2: Medium Height Buildings (10m to < 25m)

The comparative fire safety index scores for medium rise buildings in the WL purpose group buildings are shown in Figure 6 – WL 2: 10m to < 25m. The major reasons for the differences in the scoring for each of the buildings in each country are identified in the following sections.

WL 2: Medium Height (10m to <25m), Occupant load less than 50 People

For WL 2 purpose group buildings with an escape height in the range from 10m to < 25 m (3 storeys to 10 storeys) and an occupant load of less than 50 people the New Zealand buildings have a higher fire safety index score (2.8) than South African buildings (B3 – 2.5; D3 – 2.4; J3 – 2.7 and G1 – 2.3). The higher fire safety index score for New Zealand buildings over South African buildings is mainly attributed to the Structural fire endurance rating having a requirement of 120 minutes compared to 30 minutes (+ 0.2886) and a Type 3 fire alarm system being a requirement for the New Zealand buildings with an increase for the alarm type (+ 0.3528) which is offset against the increased travel distances permitted, which brings about an overall difference over the South African B3 and D3 occupancies of approximately + 0.3 to + 0.4.

The South African J3 occupancy is only 0.1 less than the New Zealand building and is not considered significant enough to warrant further analysis. The G1 (Offices) (2.3) significantly lower than the New Zealand WL (2.8). This is put down to several categories having lower attribute scores than the comparable New Zealand building. These are: Structural Fire Endurance Rating (30 minutes), Fire Alarm Type (None), and no Direct Alarm connection to the Fire Service.

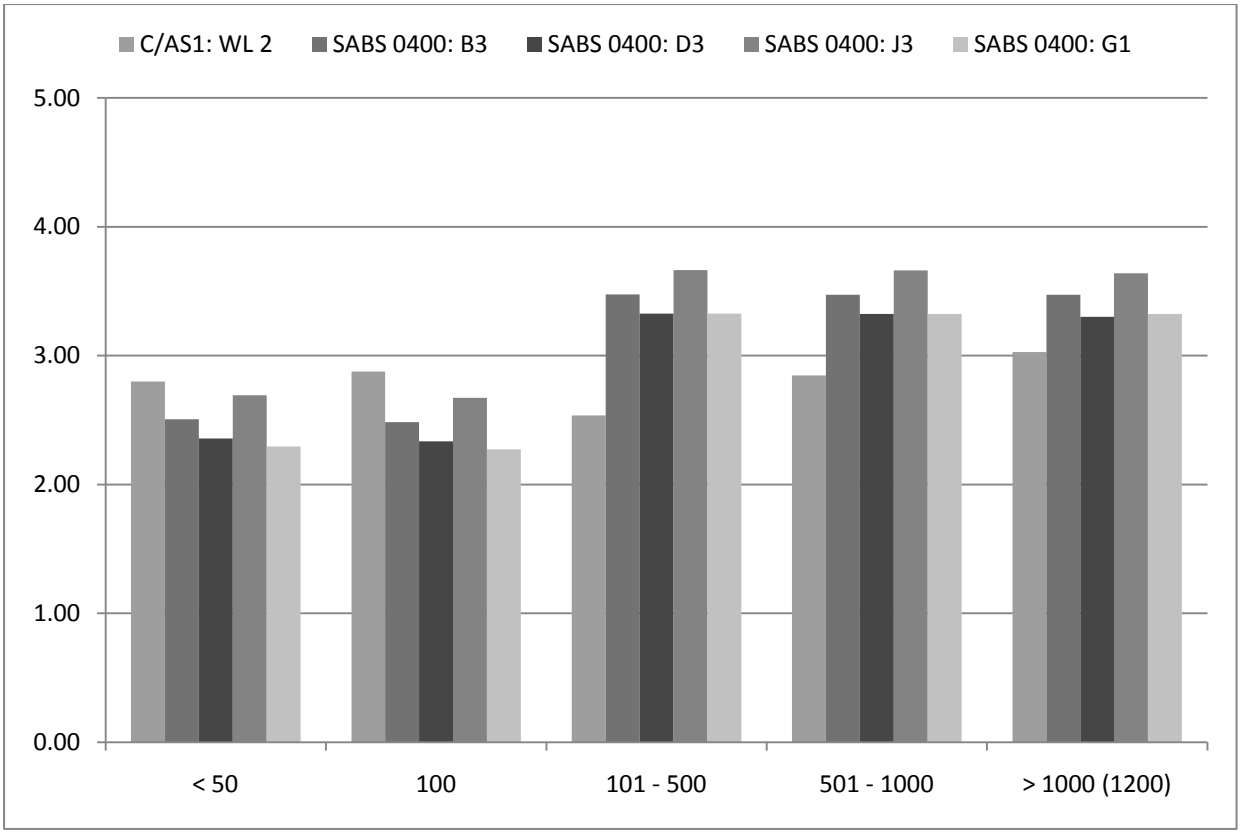

Figure 6 – WL 2: 10m to < 25m

WL 2: Medium Height (10m to <25m), Occupant load less than 100 People

When this category of buildings with an escape height of between 10 m and 25 m has an occupant load of 100 people, similar patterns appear as for the previous section which discussed the 50 person occupant load scenario; with New Zealand buildings again having a similarly higher fire safety index score than the South African buildings. The reasons for the New Zealand buildings outscoring South African buildings are much the same as for the previous section and this report will not comment any further for this occupant load category.

WL 2: Medium Height (10m to <25m), Occupant load greater than 100 and up to 500 People

When the building occupant load increases into the range of above 100 people up to 500 people there is again a noticeable difference in the fire safety index scoring, with all South African buildings again substantially out-scoring New Zealand buildings. As before, the main reason for this is that the occupant load has caused the floor area required to maintain that occupant load to exceed the limits which trigger the requirement for automatic fire sprinklers. For the South African buildings under consideration an automatic fire alarm system with

smoke detectors also comes into play. In the case of South African buildings the requirement for the installation of a smoke detection system increases the score by + 0.588 and the requirement to install an automatic fire sprinkler system increases the score by + 0.3565 for a wet pipe sprinkler system and a dual superior water supply (+ 0.095). There are no trade-offs permitted in terms of increased travel distances when either automatic smoke detection or automatic fire sprinklers are installed.

A trade-off is, however, permitted in terms of reduced requirements for the surface finishes of occupied spaces. This is the same for New Zealand buildings and therefore there is no net difference in scoring between the buildings for this requirement.

For the New Zealand buildings, automatic fire sprinklers are also required for these occupant loads and building heights. The installation of an automatic fire sprinkler system again increases the fire safety features scoring, but the increase is again offset by the reduction in attribute scores attained because of the trade-offs permitted by virtue of increased maximum travel distances.

WL 2: Medium Height (10m to <25m), Occupant load greater than 500 and up to 1000 People

As the occupant load increases to the range of 501 to 1000 occupants the South African fire safety features remains fairly constant, except for the small decrease attributed to the reduction in building use score as the occupant load increases. The increase in the total for the building fire safety index score for New Zealand buildings is primarily influenced by the upgrading from Type 2 manual fire alarm system to a Type 4 automatic fire alarm system with smoke detection and has a net increase of + 0.353. An automatic fire sprinkler system (+ 0.3565) with a single water supply (+ 0.038), a net increase (+ 0.0221) in Fire Fighting Access (Fire Hydrants) are positive contributors to the score line, while additional trade-offs allowing increased travel distances again reduce the impact of the additional fire safety features.

It is noted that for the South African B3 and G1 occupancies the maximum permissible firecell division floor area is reached. The effect of this maximum permissible floor area is to cap the maximum permitted occupant numbers at 667 people. However as this group of comparisons is for buildings with a maximum occupant load of 1000 people the Attribute

Score remains at 2 (501 < Occ. No. ≤ 1000) and does not affect the building use features score. South African buildings remain with higher overall scores than the New Zealand buildings.

WL 2: Medium Height (10m to <25m), Occupant load greater than 1000 People

Once again for this occupant load category, an occupant load of 1200 people is arbitrarily taken as certain calculations are dependent on a reasonably exact occupant number. For the scores for this occupant load category there are again minor changes primarily caused by the decrease in building use score as the occupant load increases.

It is noted that for the South African B3 and G1 occupancies the building use score actually increases when compared to the other buildings in this category as the maximum permissible floor areas for the fire cell divisions is attained and no further increases in floor area is permitted as there are already automatic fire sprinklers installed. The effect of this maximum permissible floor area is to cap the maximum permitted occupant numbers at 667 people which effectively forces a higher attribute score for these buildings compared to the others under consideration.

Apart from these areas there are no other significant items which require any discussion.

5.5.4. WL 2: High Rise Buildings (> 33m)

Figure 7 – WL2: 34m to < 46m shows the comparative fire safety index scoring for high rise buildings in the WL purpose groups. The main contributors to the differences in the scoring for the buildings in each country are also identified in the following sections.

WL 2: High Rise Buildings (> 33m), Occupant load less than 50 People

For High rise buildings with an escape height of more than 33 metres and an occupant load of 50 people all South African buildings have a higher fire safety index score than the comparative New Zealand buildings. For the B3; D3 and J3 occupancy classes the difference is a significant value of around + 0.7. This is attributed to the fact that all of the South African buildings are required to have an automatic fire sprinkler system installed. While New Zealand buildings of this height also require automatic fire sprinklers, the gain in attribute score is always offset against the permitted trade-offs (primarily increased maximum permissible travel distances).

South African buildings with the occupancy class G1 (Offices) at this height and occupant load noticeably do not require an automatic fire sprinkler system. However it is noted that this building still has a higher fire safety index score than the New Zealand equivalent. The main fire safety features that contribute positively to this difference in score in favour of the South African buildings are: Firecell Rating (+ 0.3); Type 4 Fire Alarm (+ 0.235); and Stairwell Pressurisation (+ 0.1005). While New Zealand buildings noticeably have automatic fire sprinklers their benefit is once again offset by the permissible trade-offs in maximum permissible travel distances.

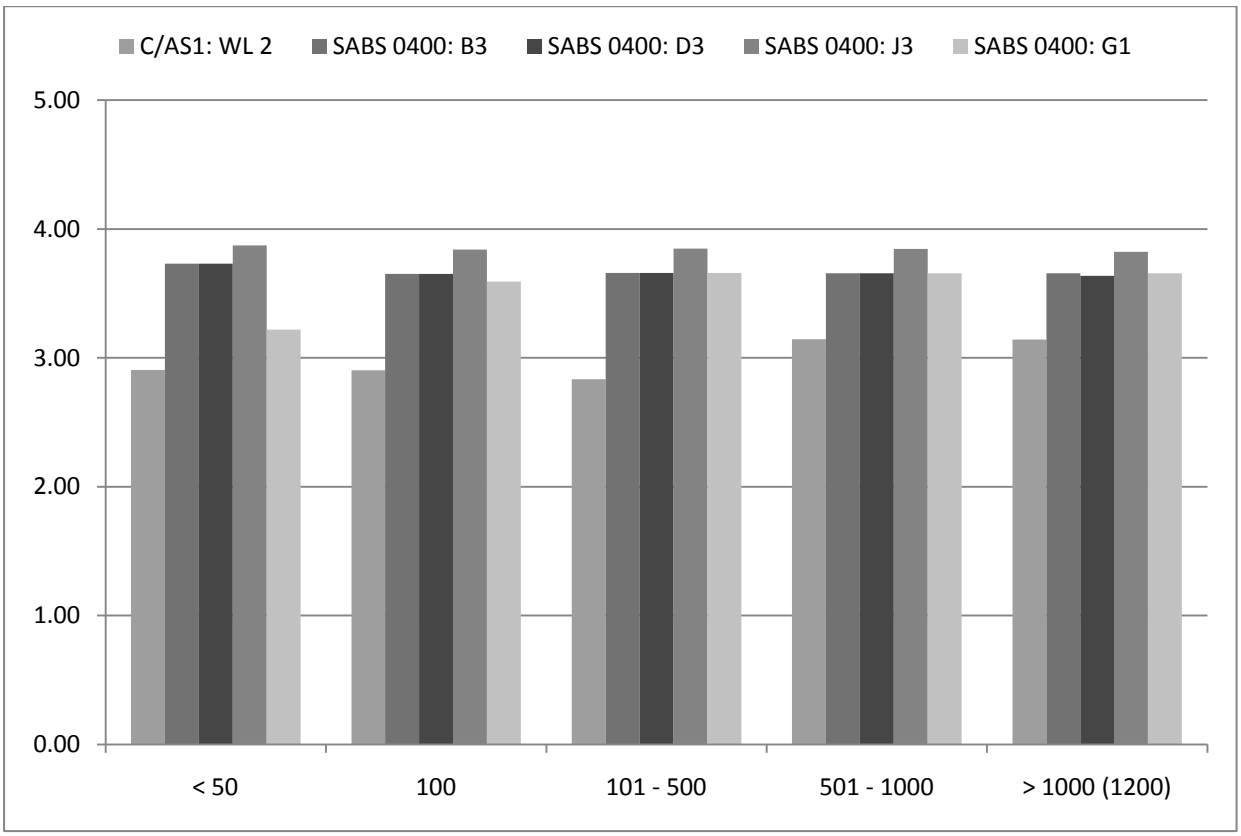

Figure 7 – WL2: 34m to < 46m

WL 2: High Rise Buildings (> 33m), Occupant load less than 100 People

In this category of buildings the South African buildings continue their trend of outscoring the New Zealand buildings. The South African G1 (Offices) buildings now also require automatic fire sprinklers to be installed, as the fire cell division floor area has increased above 500 m^2. The scoring for the Office building then comes back into line with the other South African building occupancies.

WL 2: High Rise Buildings (> 33m), Occupant load greater than 100 and up to 500 People

Once the occupant load of the building moves into the occupant load range of above 100 people up to 500 people the South African buildings fire safety index still out-score the New Zealand buildings. The fire safety features score for this range of buildings under both the South African Deemed to Satisfy rules and New Zealand Acceptable Solutions remains the same as for the previous occupant load. The decreases attributed to the lower building use score as the occupant increases are the only perceptible differences accounting for the slightly lower total fire safety index scores.

WL 2: High Rise Buildings (> 33m), Occupant load greater than 500 and up to 1000 People

For this category of buildings in both countries the fire safety feature remain relatively unchanged and there bar for the small decrease attributed to the reduction in building use score as the occupant load increases. The increase in the total for the building fire safety index score for New Zealand buildings is primarily influenced by the upgrading from Type 2 manual fire alarm system to a Type 4 automatic fire alarm system with smoke detection and has a net increase of + 0.353, while additional trade-offs allowing increased travel distances again reduce the impact of the additional fire safety features. It is noted that for the South African B3 and G1 occupancies the maximum permissible firecell division floor area is reached. The effect of this maximum permissible floor area is to cap the maximum permitted occupant numbers at 667 people. However as this group of comparisons is for buildings with a maximum occupant load of 1000 people the Attribute Score remains at 2 ($501 < \text{Occ. No.} \leq 1000$) and does not affect the building use features score. South African buildings remain with higher overall scores than the New Zealand buildings.

WL 2: High Rise Buildings (> 33m), Occupant load greater than 1000 People

The occupant load chosen for this category is again arbitrarily placed at 1200 people as certain calculations are dependent on a reasonably exact occupant number. The scores changes in this occupant load category are again minor changes primarily caused by the decrease in building use score as the occupant load increases. It is noted that for the South African B3 and G1 occupancies the building use score increases marginally as the maximum permissible floor areas for the fire cell divisions is attained and occupant numbers are capped

at less than 1000 people (i.e. 667) which takes the attribute score from 0 to 1. The South African buildings still have a higher overall score compared to the New Zealand equivalent C/AS1 compliant buildings. Apart from these areas there are no other significant items which require any discussion.

5.6. Working Occupancies (WL 2)

For Single Storey buildings, which comprise around 63% of the building stock, South African buildings have a higher fire safety index score than New Zealand Buildings across all occupant number categories.

In the Double Storey height range of buildings, the two occupant loads of < 50 and < 100 are both scored higher for New Zealand buildings than South African buildings, and when the occupant load increases above 100 people the South African buildings again have higher fire safety index scores.

In the height range 10 to < 25 m, the two occupant loads of < 50 and < 100 are both scored higher for New Zealand buildings than South African buildings, and when the occupant load increases above 100 people the South African buildings again have higher fire safety index scores.

Once the building height is above 34 m, all South African buildings achieve higher fire safety index scores than New Zealand buildings.

6. WORK TYPE OCCUPANCIES (MODERATE FIRE HAZARD CATEGORY WM)

6.1. General

The work type occupancies with a higher fire hazard category (FHC3) are generally categorised as WM in C/AS1. These are also regarded as "Awake and Aware" type premises. The building occupants are again involved in some type of working situation or work related activity. Building occupants and users are normally fully awake; they are not normally under the influence of alcohol, medication or other drugs. The building users will normally have a high level of comprehension and understanding. The occupants can follow instruction and are often in a structured environment with supervision, and have often had training and instruction on what to do in the event of a fire and fire evacuation drills are often mandatory in terms of Health and Safety or other Legislation. Due to the restrictions of the physical workplace and the type of work likely to be carried out in these buildings it is assumed that the presence of people with special needs or physical disabilities is likely to be low.

Working environments also have additional statutory provisions in place governing employment, such as health and safety in employment laws and regulations. In some instances regulations governing hazardous substances and materials may also impose additional safeguards in relation to fire safety. For example, in New Zealand, the Fire Safety and Evacuation of Buildings Regulations [24] also impose additional measures and impose a duty to ensure that regular building evacuation drills are carried out in terms of approved evacuation schemes or procedures. While these matters may actually increase the level of fire safety in working type buildings, they are considered to be in addition to the inherent levels of safety provided by virtue of the building construction and fire safety precautions installed in buildings, therefore such matters are not considered within the measurement of the Fire Safety Index.

6.2. Purpose Groups and Fire Hazard Categories

The purpose group for working/business type occupancies in this section of the comparison is WM (Working Moderate) and the Fire Hazard Category is 3. From the breakdown of the occupancy or building classifications applicable to this section from SANS 10400 the following classes of occupancy are compared to the C/AS1 WM 3 purpose groups as shown in Table 7 – Working Moderate Occupancies:

New Zealand	South Africa
WM 3	B2 – Moderate Risk Commercial Service
WM 3	D2 – Moderate Risk Industrial
WM 3	J2 – Moderate Risk Storage

Table 7 – Working Moderate Occupancies

6.3. Firecell Size – Maximum Division Area

In South African buildings the maximum division area size of a firecell is governed by Table 3 of Part T of SANS 10400. (Refer to Appendix G – SANS 10400 – Part T, Table 3: Maximum Division Area, m^2 on page 152 of this report). For working type purpose groups B2 (Moderate Risk Commercial) the firecell division floor area limit is 5000 m^2 where no fixed automatic fire extinguishment system (typically sprinklers) is installed. Where a fixed automatic fire extinguishment system (sprinklers) is installed in a single storey building the fire cell division size is unlimited, and in buildings two storeys and over the fire cell division size is restricted to a maximum area of 10000 m^2.

For the other working type purpose groups D2 (Moderate Risk Industrial) and J2 (Moderate Risk Storage) the firecell division floor area limit is 2500 m^2 where no fixed automatic fire extinguishment system (sprinklers) is installed. In a single storey building with fixed automatic fire extinguishment system (sprinklers) the fire cell division size is unlimited and for buildings two storeys and over the fire cell division size is restricted to a maximum area of 5000 m^2.

6.4. Fire Cell Size and Occupant Numbers

The fire cell division size in SANS 10400 also places an indirect restriction on the occupant numbers for which a fire cell division can be designed. The occupant load is a factor of available floor area, and as the occupant number increases, the floor area will of necessity have to increase commensurately. In the South African occupancies under discussion in this section (B2, D2 and J2) the occupancy load of 500 people per fire cell division necessitates the installation of an automatic sprinkler system. In the case of J2 – Moderate Risk Storage an occupant load of 500 people equates to a floor area of 25000 m^2, (500 people at 50 m^2 per

person). Because of the restrictions placed on the maximum permissible Division Area by Table 3 (maximum of 5000 m^2 for two storeys and over) the assessments for the higher occupant loads at the higher building heights will mean that these South African buildings will score slightly higher Building Use Scores than the New Zealand buildings because of the cap on occupant numbers. (Refer to Appendix G – SANS 10400 – Part T, Table 3: Maximum Division Area, m^2 on page 152 of this report). For the B2 (Moderate Risk Commercial Service) and D2 (Moderate Risk Industrial) this occupant load cap by virtue of the maximum permissible fire cell division area occurs when the occupant load exceeds 666 people for B2 (666 people at 15 m^2 per person = 10000m^2) and 333 people for D2 (333 people at 15 m^2 per person = 5000m^2), and again the Building Use Scores are higher for the South African buildings.

6.5. Fire Safety Index Results

Calculation of the Fire Safety Index Scores for buildings in this section are carried out using the spreadsheets which start with Appendix AJ – Fire Safety Index Calculations – PG: WM (0m, ≤ 50 occupants on page 200 and continue through to Appendix AS – Fire Safety Index Calculations – PG: WM (≤ 4m, ≤ 1200 occupants. The calculations for the other building heights are not included in the appendices. The results of the fire safety index calculations for this purpose group are shown in Table 8 – Fire Safety Index: Working Moderate Purpose Groups.

Height	**Building Classification**	**Occupant Number**				
		< 50	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**
0 m	**C/AS1: WM3**	1.47	1.72	1.81	1.99	2.35
	SANS 10400: B2	1.80	1.80	2.23	3.00	2.98
	SANS 10400: D2	1.80	1.80	2.23	3.00	2.98
	SANS 10400: J2	2.05	2.35	2.37	3.14	3.12
< 4 m	**C/AS1: WM3**	2.27	2.51	2.61	2.78	2.65
	SANS 10400: B2	2.30	2.31	2.72	3.30	3.30
	SANS 10400: D2	2.30	2.31	2.72	3.32	3.32
	SANS 10400: J2	2.35	2.68	2.70	3.49	3.49

Height	Building Classification	Occupant Number				
		< 50	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**
4 m to 10 m	**C/AS1: WM3**	2.71	2.69	2.71	2.89	2.65
	SANS 10400: B2	2.48	2.46	2.87	3.45	3.45
	SANS 10400: D2	2.48	2.46	2.87	3.48	3.48
	SANS 10400: J2	2.37	2.68	2.70	3.49	3.64
10 m to 25 m	**C/AS1: WM3**	2.99	2.98	2.97	2.92	2.67
	SANS 10400: B2	2.41	2.40	2.80	3.39	3.39
	SANS 10400: D2	2.41	2.40	2.80	3.41	3.41
	SANS 10400: J2	2.31	2.61	2.63	3.42	3.57
25 m to 34 m	**C/AS1: WM3**	2.54	2.52	2.52	2.85	2.85
	SANS 10400: B2	2.34	2.33	2.73	3.32	3.32
	SANS 10400: D2	2.34	2.33	2.73	3.34	3.34
	SANS 10400: J2	2.24	2.54	2.56	3.36	3.51
34 m to 46 m	**C/AS1: WM3**	2.90	2.89	2.88	3.21	3.21
	SANS 10400: B2	3.59	3.58	3.57	3.57	3.57
	SANS 10400: D2	3.59	3.58	3.57	3.59	3.59
	SANS 10400: J2	3.55	3.53	3.55	3.76	3.76

Table 8 – Fire Safety Index: Working Moderate Purpose Groups

6.6. Fire Safety Index Comparisons (WM)

6.6.1. WM 3: Single Storey (0m)

The comparative fire safety index scores for a single level building in the WM purpose groups are shown in Figure 8 – WM 3: Single Storey (0m). The main reasons for the differences in the scoring for each of the various buildings in each country are highlighted in the following sections.

WM 3: Single Storey, Occupant load less than 50 People

For WM 3 Purpose Group buildings which are Single Storey (Escape Height 0m) the buildings in the three South African classifications all have a higher fire safety index score when the occupant load is less than 50 people. This higher fire safety index score for South

African buildings is attributed primarily to the Firecell rating requirement (+ 0.3008), the requirement for smoke control (automatic natural smoke ventilation +0.804), the requirement for two escape routes (+ 0.0392) and a minimum width of 1200mm (+ 0.0196). The provision of fire hose reels and portable fire extinguishers for occupant fire fighting also contributes (+0.024). The B2 and D2 buildings only require a Structural fire endurance of 30 minutes (+ 0.0962), while the J2 building requires 60 minutes (+0.1924).

New Zealand buildings have no Firecell rating (0.000), only require a single escape route (0.000) and have an escape route width of < 1000mm (0.000). In addition the maximum permissible lengths for the open paths (Dead-end Open Path and Total Open Path) further reduce the New Zealand buildings score, but the requirement for a 60 minute Structural fire endurance of 60 minutes (+ 0.1924), emergency lighting at the final exit (+0.102) reduces some of the scoring difference between the buildings

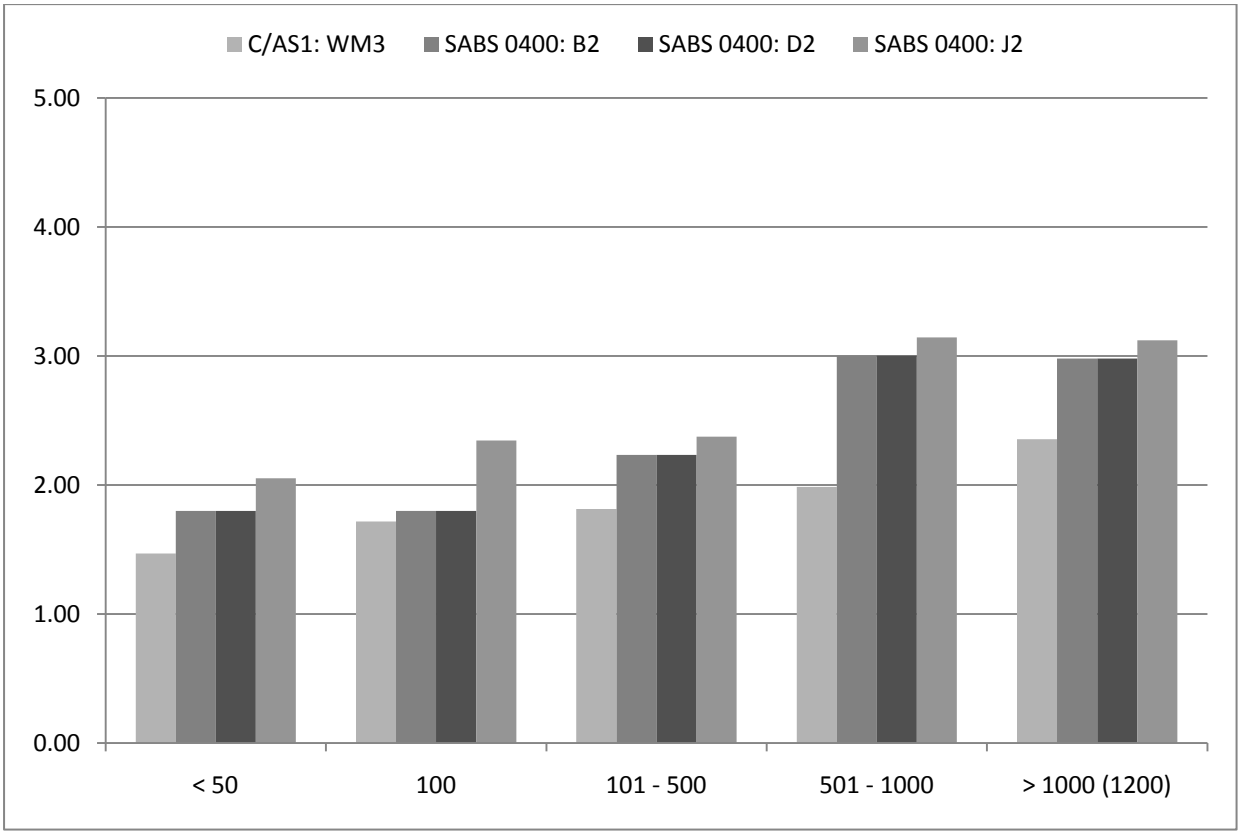

Figure 8 – WM 3: Single Storey (0m)

WM 3: Single Storey, Occupant load less than 100 People

For Single Storey Buildings with an occupant load of 100 people, there is no significant difference in the fire safety index scores for the New Zealand WM 3 and the South African B2 and D2. The fire safety index score recovery for the New Zealand buildings is attributed to the requirement for the provision of a manual fire alarm system (+0.235), the provision of two fire escape routes (which has a net difference of + 0.0196) and the installation of emergency lighting in open paths (+0.0255).

For the South African J2 (Moderate Risk Storage) building the occupant load of 100 people pushes the fire cell division area to 5000m^2 thereby triggering the requirement for automatic fire sprinklers. This increases the fire safety features score for wet pipe sprinkler system (+0.3565) and dual superior water supply (+ 0.095).

WM 3: Single Storey, Occupant load greater than 100 and up to 500 People

When the building occupant load increases into the range of above 100 people up to 500 people the South African buildings again out-score the New Zealand buildings.

The main reason for this is that the occupant load for the South African B2 and D2 buildings has now also caused the floor area required to maintain that occupant load to exceed the limits which trigger the requirement for automatic fire sprinklers. The occupant load increase also requires the number of escape routes to increase to three (+ 0.0196). In the case of South African buildings the requirement for automatic fire sprinklers to be installed increases the score for a wet pipe sprinkler system (+ 0.3565) as well as dual superior water supply (+ 0.095). As is the case in all South African buildings, there are no trade-offs permitted in terms of increased travel distances when either automatic smoke detection or automatic fire sprinklers are installed.

Trade-offs are, however, permitted in terms of reduced requirements for the surface finishes of occupied spaces. This is the same for New Zealand buildings and therefore there is no net difference in scoring between the buildings for this requirement.

WM 3: Single Storey, Occupant load greater than 500 and up to 1000 People

Once the building occupant load range moves into the numbers of 501 to 1000 people the South African buildings fire safety features scores markedly outrank the New Zealand buildings. The reason for the jump in the fire safety index score for the South African buildings is primarily influenced by the new requirement for the installation of an automatic

fire alarm system with smoke detection which adds a net increase of (+ 0.588), and automatic shutdown of air-conditioning (HVAC) systems (+0.184).

WM 3: Single Storey, Occupant load greater than 1000 People

The occupant load chosen for this section is again set arbitrarily at 1200 people as certain calculations are dependent on a reasonably exact occupant number. For the South African buildings there is again a minor decrease in the building use score due to the increase in the occupant load, with the fire safety features score remaining the same.

The New Zealand fire safety features score increases because of the installation of a wet pipe automatic fire sprinkler system (+ 0.3565) and single water supply (+ 0.038) and a direct connection to the Fire Service (+0.133). These increases are again offset by the trade-offs allowed in terms of increased maximum permissible travel distances, which reduces the net effect on the fire safety features scoring.

6.6.2. WM 3: Double Storey (<4m)

The comparative fire safety index scores for double storey buildings in the WM purpose groups are shown in Figure 9 – WM 3: Double Storey (< 4m). The reasons for any large differences in scoring across each country are identified in the following sections.

WM 3: Double Storey, Occupant load less than 50 People

For Double Storey Buildings (Escape Height less than 4.0m) with an occupant load of less than 50 people in the WM 3 purpose group buildings in both countries have very similar scores, with South African buildings having marginally higher scores than the New Zealand buildings. It is therefore considered that the buildings are equally safe. Accordingly this report will not discuss these buildings any further.

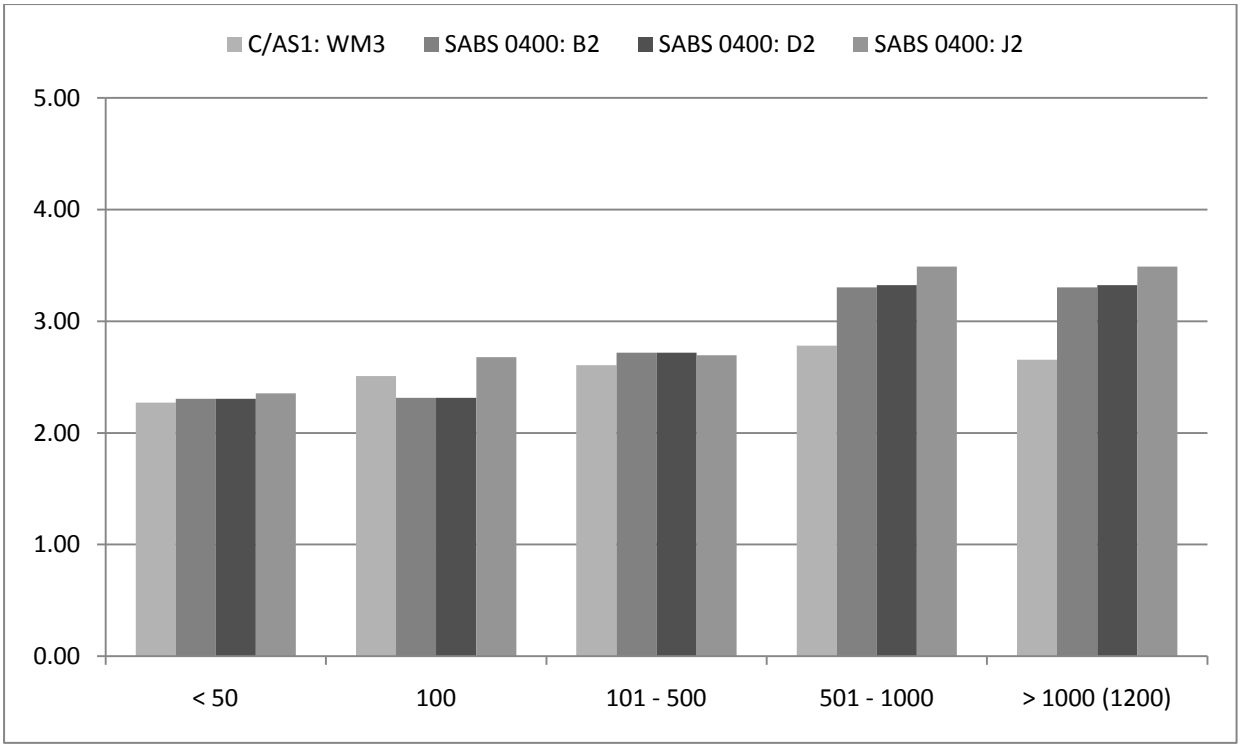

Figure 9 – WM 3: Double Storey (< 4m)

WM 3: Double Storey (<4m), Occupant load less than 100 People

For Double Storey Buildings (escape height < 4.0m) with an occupant load of less than 100 people in the WM 3 purpose group New Zealand buildings again have a higher fire safety index score than South African B2 and D2 occupancy category buildings. This is attributed to the increase in fire safety features score for New Zealand buildings as a result of the requirement for a manual fire alarms system (+ 0.235).

The South African J2 (Moderate Risk Storage) building type has a slightly higher total score than the other buildings, which is caused by the requirement for automatic fire sprinklers. The requirement for automatic fire sprinklers is triggered by the occupant load causing the fire cell division area to reach 5000m^2. This increases the fire safety features score for wet pipe sprinkler system (+0.3565) and dual superior water supply (+ 0.095).

WM 3: Double Storey (<4m), Occupant load greater than 100 and up to 500 People

For this building height and occupancy load category both sets of buildings have very similar total scores (2.61; 2.72; 2.72 & 2.70). As the difference in scoring is relatively insignificant it can be said that a WM 3 building constructed to the relevant prescriptive rules in either

country are as safe as each other and no further comment will be made for this group of buildings.

WM 3: Double Storey (<4m), Occupant load greater than 500 and up to 1000 People

Once the occupant load falls into the range of 501 to 1000 occupants, the South African buildings fire safety features again appear to have a higher score than the New Zealand buildings. The reasons for the marked increase in score over the WM 3 building are two-fold: Firstly the occupant loads for the South African buildings (D2: 333 people and J2: 100 people) are capped by virtue of the maximum permissible fire cell division floor areas which increase the Building Use Score of each, and the fire safety features score of the South African buildings increases because of the additional requirement for an automatic smoke detection fire alarm system (+ 0.588). Once again the score does not get offset against any travel distance allowances as would be the case in C/AS1.

WM 3: Double Storey, (<4m) Occupant load greater than 1000 People

As before, an occupant load of 1200 people is arbitrarily chosen for use in this category. The total fire safety features scores remains fairly constant, except for the small decrease attributed to the reduction in building use score as the occupant load increases. As only minor changes occur to the total fire safety index score across buildings in both countries when the building occupant load is set at 1200 people and there are no significant changes to the differences in score from the previous occupant load category, this section will not comment further, as the South African buildings still out-rank New Zealand buildings.

6.6.3. WM 3: Medium Height Buildings (10 to < 25m)

The comparative fire safety index scores for medium height buildings in the WM purpose groups are shown in Figure 10 – WM 3: 10 to < 25m. The major reasons for the differences in the scoring for the various buildings in each country are identified in the following sections.

WM 3: Medium Height (10m to <25m), Occupant load less than 50 People

In this category WM 3 purpose group buildings with an escape height in the range from 10m to < 25 m (3 storeys to 10 storeys) and an occupant load of less than 50 people the New Zealand buildings have a higher fire safety index score (2.9) than South African buildings

(B2 – 2.4; D2 – 2.4 and J2 – 2.3). For New Zealand buildings the higher fire safety index score compared to the South African buildings is mainly attributed to: the higher Structural fire endurance rating (+ 0.3848) and a Type 3 fire alarm system being a requirement for the New Zealand buildings (+ 0.3528). Once again, some of the increases gained through having a Type 3 fire alarm system (Heat detectors) are offset against the increased maximum permissible travel distances.

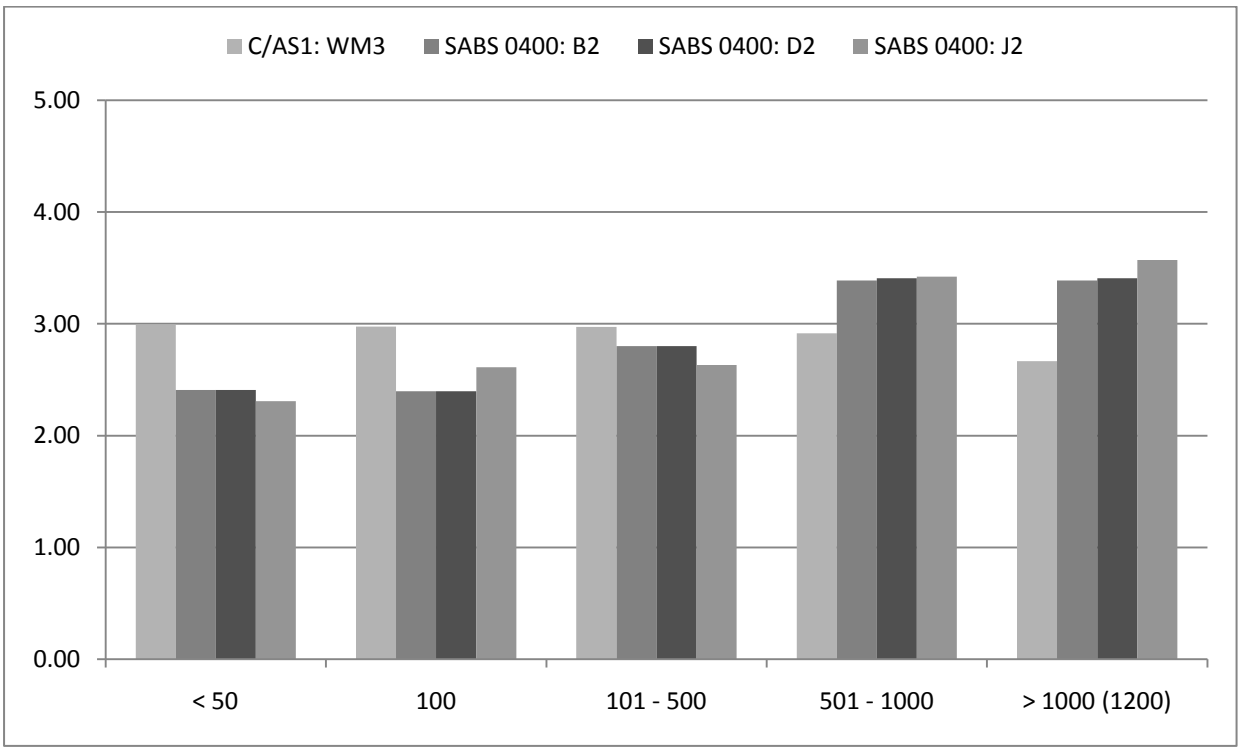

Figure 10 – WM 3: 10 to < 25m

WM 3: Medium Height (10m to <25m), Occupant load less than 100 People

For this category of buildings with an escape height of between 10 m and 25 m and an occupant load of 100 people, a similar result occurs as for the previous section which discussed the 50 person occupant load scenario; with New Zealand buildings again having a similarly higher fire safety index score than the South African buildings. The reasons for the New Zealand buildings outscoring South African buildings are much the same as for the previous section and this report will not comment any further for this occupant load category. The only noticeable change is for the South African J2 building, which increases because of the requirement for a wet pipe automatic fire sprinkler system to be installed (+ 0.3565) and

dual superior water supply (+ 0.095), which is slightly offset by the reduced requirements for surface finishes (- 0.1362).

WM 3: Medium Height (10m to <25m), Occupant load greater than 100 and up to 500 People

When the building occupant load increases into the range of above 100 people up to 500 people the New Zealand buildings continue to out-score the South African buildings. It is, however, noticeable that the fire safety index score for the South African B2 and D2 buildings moves closer to the WM 3 buildings, as (2.8 : 2.9) as automatic fire sprinklers again become mandatory for these buildings. This is because the occupant load ratio has caused the floor area required to maintain that occupant load to exceed the limits which trigger the requirement for automatic fire sprinklers. In the case of South African buildings the requirement for the installation of an automatic fire sprinkler system increases the score by (+ 0.3565) for a wet pipe sprinkler system as well as a dual superior water supply (+ 0.095). There are no trade-offs permitted in terms of increased travel distances when either automatic smoke detection or automatic fire sprinklers are installed.

A trade-off is, however, permitted in terms of reduced requirements for the surface finishes of occupied spaces. This is the same for New Zealand buildings and therefore there is no net difference in scoring between the buildings for this requirement.

WM 3: Medium Height (10m to <25m), Occupant load greater than 500 and up to 1000 People

As the occupant load increases to the range of 501 to 1000 occupants the South African fire safety features outscores the New Zealand buildings. The sudden increase in the fire safety features scoring for the South African buildings is caused by various factors. In the first instance, the occupant numbers for the B2 and J2 buildings are reached as dictated by the maximum permissible fire cell division area (i.e. 333 people and 100 people) which automatically raises the building use scores. Where the WM and B2 buildings have a building use score of 0.5417 these have scores of 0.5638 and 0.5859 respectively. In addition, the increase in the total for the building fire safety index score for the South African buildings is brought about by the requirement for an automatic fire alarm system with smoke detection and has a net increase of (+ 0.353).

For the New Zealand building, an automatic fire sprinkler system (+ 0.3565) with a single water supply (+ 0.038), as well as an upgrade from a Type 3 automatic fire alarm system (heat detectors) to a Type 4 system with smoke detection (+ 0.2352) is now a requirement. However these increases to the building fire safety index are again offset against the additional trade-offs which allowing for increased travel distances. There is also a small reduction noticeable, which is attributed to the reduced fire cell rating (- 0.3008) and structural fire endurance rating (- 0.1924) allowed when sprinklers are installed.

WM 3: Medium Height (10m to <25m), Occupant load greater than 1000 People

Once again for this occupant load category, an occupant load of 1200 people is arbitrarily taken as certain calculations are dependent on a reasonably exact occupant number. For the scores for this occupant load category there are again minor changes primarily caused by the decrease in building use score as the occupant load increases. South African buildings remain with higher overall scores than the New Zealand buildings.

For the New Zealand building there is a marked drop in the total fire safety index score from 2.916 for the previous occupancy load category to 2.667 for this occupancy load. Apart from the slight change to the building use score due to the reduction in attribute score as the height increased there is also reduction in fire cell rating.

The fire cell rating reduces from 45 minutes for the occupant load 501 to 1000 (refer to Appendix K – C/AS1 – Table 4.1/3: Fire Safety Precautions: (501 to 1000 people) on page 156 of this report) to 30 minutes when the occupant load is over 1000 (refer to Appendix L – C/AS1 – Table 4.1/4: Fire Safety Precautions: (over 1000 people) on page 157 of this report). (This apparent anomaly also occurs for the WH 4 section of the aforementioned Tables)

The reason for the permitted reduction in the fire cell rating is not immediately obvious as such a reduction is normally only seen when buildings change from non-sprinklered firecells to sprinkler protected firecells. The effect of this reduction is also to reduce the assumed structural fire endurance rating. Following McGhie's [3] convention, the structural fire endurance rating for all New Zealand buildings has been assumed to be twice the firecell rating. It is unclear whether this apparent inconsistency is purely a typographical error or if there is some other reason for it. As this report compares similar buildings which meet the requirements of the relevant Acceptable Solution this apparent anomaly will be accepted at face value and the relevant attribute score for the fire cell rating and structural fire endurance rating stands.

6.6.4. WM 3: High Rise Buildings (> 33m)

Figure 11 – WM 3: 34m to < 46m, shows the comparative fire safety index scoring for high rise buildings in the WM purpose group. The main contributors to the differences in the scoring for the buildings in each country are also identified in the following sections.

WM 3: High Rise Buildings (> 33m), Occupant load less than 50 People

For this category of buildings which are considered to be high rise with an escape height of more than 33 metres and an occupant load of 50 people all South African buildings have a higher fire safety index score than the comparative New Zealand buildings. The South African buildings all have a significant total fire safety index score rating advantage of around (+ 0.6). This is attributed to the fact that all of the South African buildings are required to have an automatic fire sprinkler system installed.

While New Zealand buildings of this height also require automatic fire sprinklers, the gain in attribute score is always offset against the permitted trade-offs (primarily increased maximum permissible travel distances).

Other fire safety features that contribute positively to this difference in score in favour of the South African buildings are: Firecell Rating (+ 0.15); Automatic Smoke Detection Fire Alarm (+ 0.353); and Stairwell Pressurisation (+ 0.1005). While New Zealand buildings noticeably have automatic fire sprinklers their benefit is once again offset by the permissible trade-offs in maximum permissible travel distances.

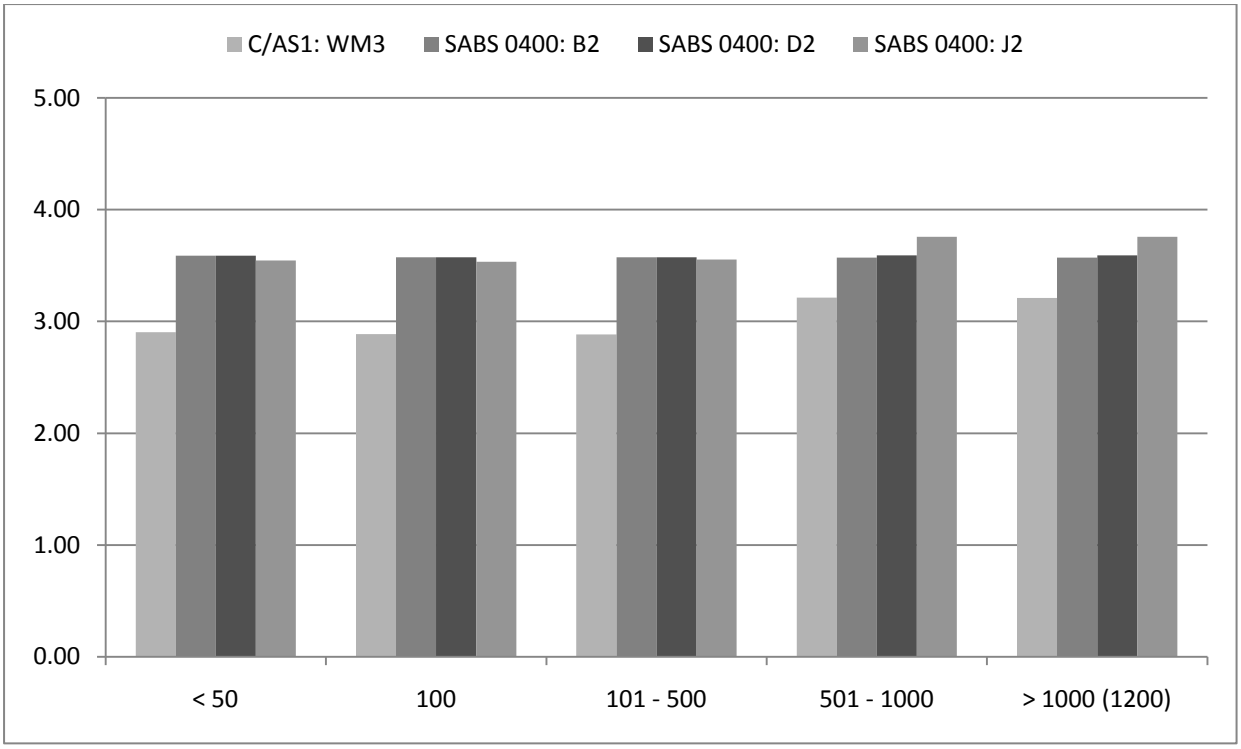

Figure 11 – WM 3: 34m to < 46m

WM 3: High Rise Buildings (> 33m), Occupant load less than 100 People

The South African buildings continue their trend of outscoring the New Zealand buildings in approximately the same ratio as for the previous category for less than 50 people, and no further comment is necessary.

WM 3: High Rise Buildings (> 33m), Occupant load greater than 100 and up to 500 People

Once the occupant load of the building moves into the occupant load range of above 100 people up to 500 people the South African buildings fire safety index still out-score the New Zealand buildings, and this report will not make any further comment in this area.

WM 3: High Rise Buildings (> 33m), Occupant load greater than 500 and up to 1000 People

For this category of buildings in both countries the fire safety feature remain relatively unchanged, bar for the small decreases attributed to the reduction in building use score as the occupant load increases, and South African buildings remain with higher overall scores than the New Zealand buildings. It is noted that the fire safety index score for New Zealand

buildings has an increase which is primarily influenced by the requirement for a Type 4 automatic fire alarm system with smoke detection to be installed which has a net increase of (+ 0.353), while additional trade-offs allowing increased travel distances again reduce the impact of the additional fire safety features.

For the South African D2 and J2 occupancies the maximum permissible firecell division floor area is reached. This causes the occupant load to be capped which causes an increase in the building use score for each of these buildings and primarily accounts for the stepped effect which is seen in the graph.

WM 3: High Rise Buildings (> 33m), Occupant load greater than 1000 People

An occupant load of 1200 people is again used for this category. The score changes in this occupant load category are again minor decreases caused by the decrease in building use score as the occupant load increases. The exception is the South African D2 and J2 occupancies which have an occupant load cap due to the restriction on maximum permissible firecell division floor area.

The fire safety features scores for this range of buildings under both the South African Deemed to Satisfy rules and New Zealand Acceptable Solutions remains the same as for the previous occupant load. The South African buildings therefore still have a higher overall fire safety index score than the equivalent New Zealand C/AS1 compliant buildings. Apart from these areas there are no other significant items which require any discussion.

6.7. Working Moderate Type Occupancies (WM 3)

For all occupant number evaluations of Single Storey buildings, the equivalent South African buildings have a higher fire safety index score than New Zealand Buildings, and are considered to be safer.

In the Double Storey height range of buildings, buildings with an occupant load of 50 people are equally safe in both countries. For buildings with an occupant load of < 100 people the New Zealand buildings appear safer than South African buildings. For the occupant load category of 101 to 500 people, New Zealand and South African buildings are again equally

safe. Once the occupant load increases above 500 people the South African buildings again have higher fire safety index scores.

In the height range 10 to < 25 m, the three occupant load categories of ≤ 50; ≤ 100 and ≤500 people all show that the New Zealand buildings are safer than South African buildings. For the remaining two occupancy categories for this building height range the South African buildings again have higher fire safety index scores.

Once the building height is above 34 m, all South African buildings achieve higher fire safety index scores than New Zealand buildings.

7. CROWD ACTIVITY OCCUPANCIES (CS/CL – LOW FIRE HAZARD CATEGORY)

7.1. General

Crowd Activity type occupancies have special inherent factors which need consideration. While the occupants are often (mostly) "Awake" they are not necessarily "Aware". The majority of occupants cannot be considered to be familiar with the premises. While some of the occupants are involved in some type of work or work related activity, the vast majority of people are visitors to the premises who are usually involved in some form of leisure activity. Crowd Activities often take place at night or during the hours of darkness which increases the spatial disorientation of participants. The occupants may be under the influence of alcohol, medication or other drugs (legal or otherwise). The occupants cannot be assumed to have any reasonable level of comprehension and understanding. The occupants are not considered to be in any form of structured environment and are not considered to be under any form of supervision.

The presence of people with physical and/or intellectual disabilities may be in greater numbers than in working type situations and is more likely to be in line with general population statistics, and in some case e.g. conferences, large numbers of people with disabilities can be expected to congregate. It is also worth noting that legislation bars discrimination on the grounds of disability (or special needs), and in fact other parts of building legislation specifically requires provision to be made for disabled people to be catered for. In the case of buildings with fixed or tiered seating such as theatres provision must be made for spaces for wheelchairs adjacent to other seating.

Crowd Activity occupancies may also have additional statutory provisions in place governing fire safety, general safety and evacuation of public buildings. In New Zealand the Fire Safety and Evacuation of Buildings Regulations [24] also impose additional measures and impose a duty to ensure that regular building evacuation drills are carried out in terms of approved evacuation schemes or procedures.

While some of these matters may have a positive influence on fire safety, other factors mentioned can have a detrimental effect on the level of fire safety in crowd space occupancy type buildings. These are, however, considered to be extraneous to the levels of safety provided by virtue of the building construction and fire safety precautions installed in

buildings, therefore such matters are not considered within the measurement of the Fire Safety Index.

7.2. Purpose Groups and Fire Hazard Categories

The purpose group for Crowd Activity type occupancies in this section of the comparison is CS (Crowd small < 100 people) and CL (Crowd Large > 100 people). As the fire loading can vary across certain categories of Crowd Activity type of building, (usually Fire Hazard Category 1 and Fire Hazard Category 2), this comparison of the fire safety indices for Crowd Activity type buildings will assume that all Crowd Activity type occupancies, with the exception of the C2 Museum, have a Fire Hazard Category rating of 2. It is noted that McGhie [3] also took this approach with regard to ranking the fire hazard category. Using a higher fire hazard category errs on the side of caution, as a lower building use score is obtained. From the breakdown of the occupancy or building classifications applicable to this section from SANS 10400 the following classes of occupancy are compared to the C/AS1 CS and CL 2 purpose groups as shown in Table 9 – Crowd Activity Occupancies. It is noted that the South African C2 (Museum) has a slightly higher building use score to begin with as the fire hazard category is FHC 1, whereas the other buildings are FHC 2.

New Zealand	South Africa
CS or CL 2	A1 – Entertainment and Public Assembly
CS or CL 2	A2 – Theatrical and Indoor Sport
CS or CL 2	A3 – Places of Instruction
CS or CL 2	A4 - Worship
CS or CL 1	C2 - Museum

Table 9 – Crowd Activity Occupancies

7.3. Firecell Size – Maximum Division Area

The maximum division area size of a firecell in a South African building is restricted by Table 3 of Part T of SANS 10400. (Refer to Appendix G – SANS 10400 – Part T, Table 3: Maximum Division Area, m^2 on page 152 of this report). For Crowd Activity type occupancy purpose groups A1 (Entertainment and Public Assembly), and A3 (Places of Instruction), the

firecell division floor area limit is 2500 m^2 where no fixed automatic fire extinguishment system is installed. Where a fixed automatic fire extinguishment system (typically fire sprinklers) is installed in a single storey building the fire cell division size is unlimited, and in buildings two storeys and over the fire cell division size is restricted to a maximum area of 5000 m^2.

For Crowd Activity type occupancy purpose groups A2 (Theatrical and Indoor Sport), and C2 (Museum) the firecell division floor area limit is 5000 m^2 where no fixed automatic fire extinguishment system is installed. Where a fixed automatic fire extinguishment system (typically fire sprinklers) is installed in a single storey building the fire cell division size is unlimited, and in buildings two storeys and over the fire cell division size is restricted to a maximum area of 10000 m^2.

For the other working type purpose groups A4 (Worship) there is no firecell division floor area limit for buildings of any height.

7.4. Fire Cell Size and Occupant Numbers

The fire cell division size in SANS 10400 initially determines when fixed automatic fire sprinklers are required to be installed and also places an indirect restriction on the occupant numbers for which a fire cell division can be designed. The occupant load is a factor of available floor area, and as the occupant number increases, the floor area will have to increase to accommodate the design occupant numbers.

For the South African C2 (Museum) occupancies the maximum permissible fire cell division size when an automatic fire sprinkler system is installed is 10000 m^2, which places an occupant load limit of 500 people (10000 m^2 with 1 person per 20 m^2). In the case of A3 (Places of Instruction) the occupant load is capped at 1000 people, as the maximum permissible fire cell division floor area is 5000 m^2, (1000 people at 5 m^2 per person). Automatic fire sprinklers are mandatory to achieve this occupant load. (Refer to Appendix E – C/AS1 – Table 2.2: Occupant Densities on page 149 and Appendix G – SANS 10400 – Part T, Table 3: Maximum Division Area, m^2 on page 152 of this report).

7.5. Fire Safety Index Results

The Fire Safety Index for buildings in the Crowd Type Group Occupancies is calculated using spreadsheets which are attached as Appendices. These start with Appendix AT – Fire Safety Index Calculations – PG: CS (0m, ≤ 50 occupants on page 228 and continue through to Appendix BC – Fire Safety Index Calculations – PG: CL (≤ 4m, ≤ 1200 occupants. Fire Safety Index scores for the other building heights have been calculated on separate spreadsheets which are not included in the appendices. The results of the fire safety index calculations for this purpose group are shown in Table 10 – Fire Safety Index: Crowd Activity Occupancies.

Height	**Building Classification**	**Occupant Number**				
		< 50	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**
0 m	**C/AS1: CS / CL 2**	1.65	1.86	1.95	2.25	2.51
	SANS 10400: A1, A2	2.03	2.19	2.21	2.19	2.17
	SANS 10400: A3	1.78	1.95	1.98	1.96	1.93
	SANS 10400: A4	1.74	1.90	1.93	1.91	1.89
	SANS 10400: C2	2.18	2.38	2.86	2.83	2.81
< 4 m	**C/AS1: CS / CL 2**	2.46	2.69	2.76	3.04	2.81
	SANS 10400: A1, A2	2.23	2.51	2.51	2.49	2.47
	SANS 10400: A3	1.98	1.96	1.98	1.96	1.96
	SANS 10400: A4	2.28	2.26	2.28	2.26	2.24
	SANS 10400: C2	2.68	2.68	3.16	3.16	3.16
4 m to 10 m	**C/AS1: CS / CL 2**	3.06	3.08	3.05	3.23	3.00
	SANS 10400: A1, A2	2.68	2.66	2.67	2.64	2.62
	SANS 10400: A3	2.45	2.41	2.43	2.41	2.41
	SANS 10400: A4	2.45	2.41	2.43	2.41	2.39
	SANS 10400: C2	2.84	2.83	3.31	3.31	3.31
10 m to 25 m	**C/AS1: CS / CL 2**	3.19	3.24	3.17	2.95	2.95
	SANS 10400: A1, A2	2.64	2.61	2.62	2.60	2.58
	SANS 10400: A3	2.40	2.37	2.39	2.36	2.36
	SANS 10400: A4	2.40	2.37	2.39	2.36	2.34
	SANS 10400: C2	2.78	2.77	3.24	3.24	3.24
25 m to	**C/AS1: CS / CL 2**	3.05	3.00	2.98	3.31	3.31

Height	Building Classification	Occupant Number				
		< 50	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**
34 m	SANS 10400: A1, A2	2.57	2.55	2.55	2.53	2.51
	SANS 10400: A3	2.33	2.30	2.32	2.30	2.30
	SANS 10400: A4	2.33	2.30	2.32	2.30	2.28
	SANS 10400: C2	2.71	2.70	3.17	3.17	3.17
34 m to 46 m	**C/AS1: CS / CL 2**	2.90	3.25	3.23	3.25	3.49
	SANS 10400: A1, A2	3.62	3.60	3.61	3.59	3.57
	SANS 10400: A3	3.62	3.59	3.61	3.59	3.59
	SANS 10400: A4	3.58	3.55	3.56	3.54	3.52
	SANS 10400: C2	3.72	3.71	3.78	3.78	3.78

Table 10 – Fire Safety Index: Crowd Activity Occupancies

7.6. Fire Safety Index Comparisons Crowd Activities

7.6.1. CS/CL 2: Single Storey (0m)

For the CS/CL purpose groups, the comparative fire safety index scores for a single level building are shown in Figure 12 – CS/CL 2: Single Storey (0m). The major reasons for the differences in the scoring for the buildings in each country are discussed in the following sections.

CS 2: Single Storey, Occupant load less than 50 People

For CS 2 Purpose Group buildings which are Single Storey (Escape Height 0m) the buildings in the four South African classifications all have a higher fire safety index score when the occupant load is less than 50 people. The scoring for the A3 and A4 buildings is fairly close to the New Zealand CS 2, while the A1 & A2 and the C2 buildings have a larger difference. It is noted that the South African C2 (Museum) has a slightly higher building use score to begin with as the Fire Hazard Category rated as equivalent to C/AS1 FHC 1, whereas the other buildings have a Fire Hazard Category equivalent to FHC 2.

The higher fire safety index scores for South African buildings is attributed primarily to the Firecell rating requirement (+ 0.3008), the requirement for a manual fire alarm for the A1 & A2 and C2 buildings (+ 0.235), the requirement for two escape routes (+ 0.0392) and a

minimum width of 1200mm (+ 0.0196). The provision of fire hose reels and portable fire extinguishers for occupant fire fighting also contributes (+0.024).

New Zealand buildings have no Firecell rating (0), only require a single escape route (0) and have an escape route width of < 1000mm (0). The requirement for a 60 minute Structural fire endurance rating (+ 0.1924), and the surface finishes difference of (+0.0908) reduces some of the scoring difference between the buildings

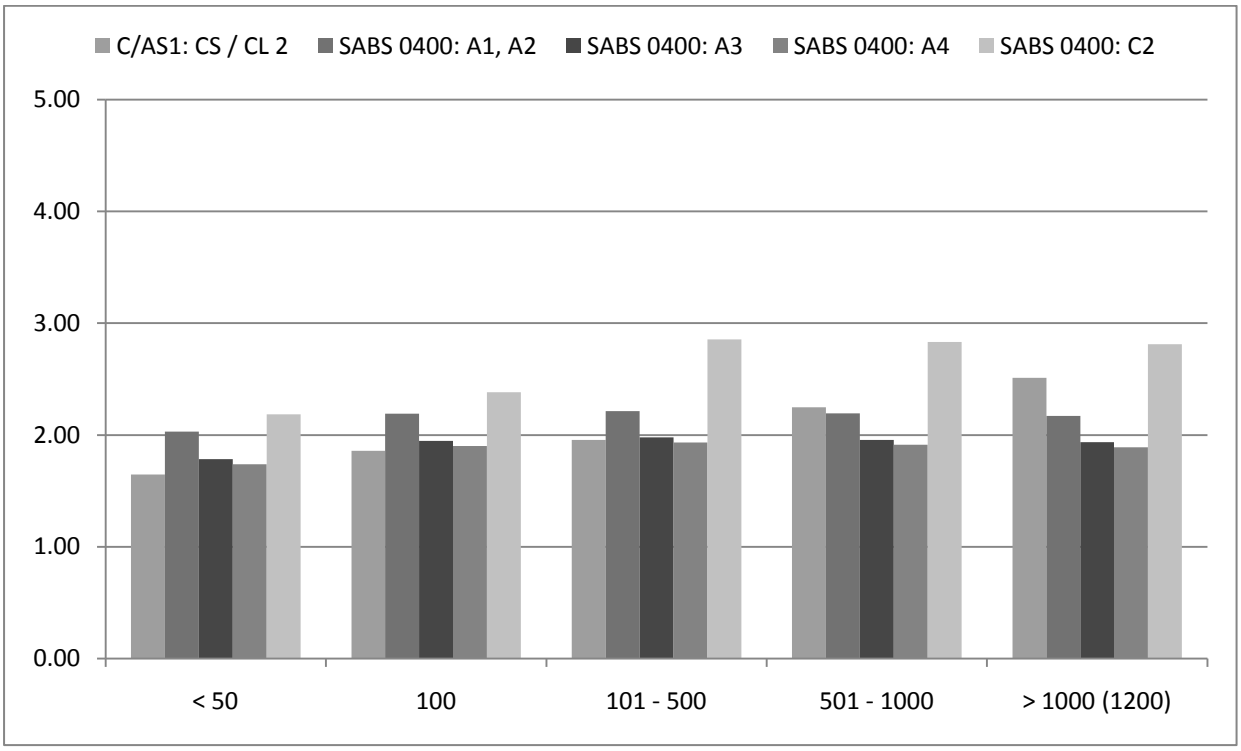

Figure 12 – CS/CL 2: Single Storey (0m)

CS 2: Single Storey, Occupant load less than 100 People

For Single Storey Buildings with an occupant load of 100 people, there is no significant change to the fire safety index scoring for both the New Zealand and South African buildings. The slight fire safety index score increase for the New Zealand buildings is attributed to the requirement for the provision of a manual fire alarm system (+0.235), the provision of two fire escape routes (which has a net difference of + 0.0196).

CL 2: Single Storey, Occupant load greater than 100 and up to 500 People

When the building occupant load increases into the range of above 100 people up to 500 people the scoring is rather more varied, with the New Zealand CL 2 out-scoring the South African A4 (Worship), and being almost the same as the A3 (Places of Instruction) buildings. The A1 & A2 buildings still have slightly higher scores than the New Zealand buildings. The C2 (Museum) has a marked jump in score due to the occupant load increasing the floor area and triggering the requirement for automatic fire sprinklers (+ 0.3565) as well as dual superior water supply (+ 0.095). For the C2 (Museum) buildings, there are no trade-offs permitted in terms of increased travel distances when either automatic smoke detection or automatic fire sprinklers are installed. A trade-off is, however, permitted in terms of reduced requirements for the surface finishes of occupied spaces.

New Zealand CL 2 buildings now have a requirement for Type 3 Heat detectors which adds +0.1178 to the score line, but this also has the effect of reducing the attribute score for the Total Open Path from 5 to 4 (- 0.0199).

CL 2: Single Storey, Occupant load greater than 500 and up to 1000 People

Once the building occupant load range moves into the numbers of 501 to 1000 people the New Zealand buildings fire safety features scores are higher than the South African buildings (Except for the C2 Museum occupancy type). The reason for the jump in the fire safety index score for the New Zealand buildings is primarily influenced by the new requirement for the installation of a Type 4 automatic fire alarm system with smoke detection which adds a net increase of + 0.2352, a direct connection to the Fire Service (+0.133), an additional escape route (+ 0.0198), increased escape route width (+ 0.0194), while the increased permitted dead-end (- 0.0398) and total open path travel distance (- 0.0398) again reduce the fire safety features scoring

CL 2: Single Storey, Occupant load greater than 1000 People

The occupant load chosen for this section is again set arbitrarily at 1200 people as certain calculations are dependent on a reasonably exact occupant number. For the South African buildings there is again a minor decrease in the building use score due to the increase in the occupant load, with the fire safety features score remaining the same.

The New Zealand fire safety features score increases because of the installation of a wet pipe automatic fire sprinkler system (+ 0.3565) and single water supply (+ 0.038) and a direct connection to the Fire Service (+0.133). These increases are again offset by the trade-offs allowed in terms of increased maximum permissible travel distances, which reduces the net effect on the fire safety features scoring.

The only South African building which remains with a higher total fire safety features score is the C2 (Museum) because of the advantage gained by the lower fire hazard category.

7.6.2. CS/CL 2: Double Storey (< 4m)

The comparative fire safety index scores for double storey buildings in the CS/CL purpose groups are shown in Figure 13 – CS/CL 2: Double Storey (< 4m). The primary contributory factors to the differences in the scoring for the buildings in each country are also identified.

CS 2: Double Storey, Occupant load less than 50 People

For Double Storey Buildings (Escape Height less than 4.0m) with an occupant load of less than 50 people in the CS 2 purpose group, New Zealand buildings are safer than South African buildings, except the C2 (Museum). This is primarily because the Firecell rating for New Zealand buildings is 60 minutes while South African A1 & A2 and A3 buildings are only 30 minutes, a difference in favour of New Zealand buildings of + 0.3008, and the increased Structural fire endurance rating of 120 minutes resulting in a net gain for New Zealand of + 0.2886 over South African buildings.

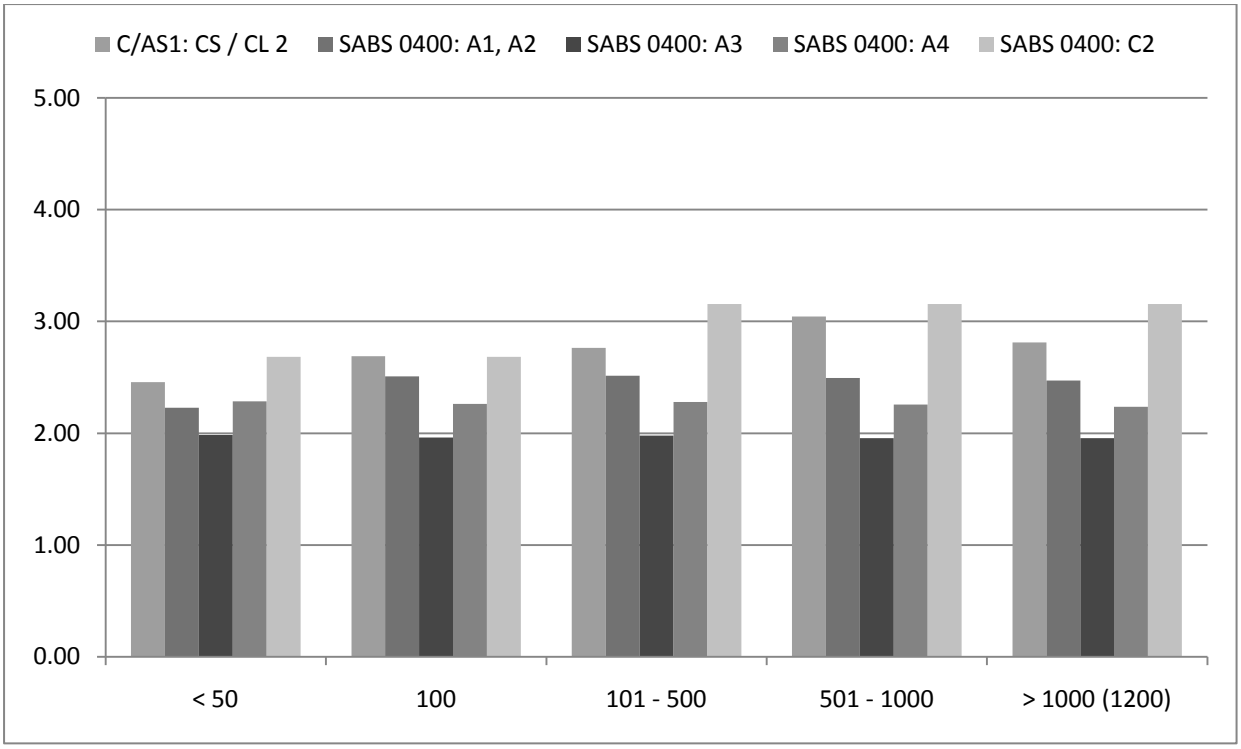

Figure 13 – CS/CL 2: Double Storey (< 4m)

CS 2: Double Storey (<4m), Occupant load less than 100 People

For Double Storey Buildings (escape height < 4.0m) with an occupant load of less than 100 people in the CS 2 purpose group New Zealand buildings again have a higher fire safety index score than all South African buildings. The increase in fire safety features score for New Zealand buildings is as a result of the requirement for a manual fire alarms system (+ 0.235), two escape routes (+ 0.0196),

CL 2: Double Storey (<4m), Occupant load greater than 100 and up to 500 People

For this building height and occupancy load category both sets of buildings have very similar total fire safety index scores as for the previous occupant load. The only exception to this is the C2 (Museum) which has an increase in the total score caused by the requirement for automatic fire sprinklers. The requirement for automatic fire sprinklers is triggered by the occupant load causing the fire cell division area to reach 5000m^2. This increases the fire safety features score for wet pipe sprinkler system (+0.3565) and dual superior water supply (+ 0.095). As the rest of the comparison remains relatively similar to the previous occupant load category no further comment will be made.

CL 2: Double Storey (<4m), Occupant load greater than 500 and up to 1000 People

For this category of buildings with an occupant load range of 501 to 1000 occupants, the trend of New Zealand buildings being safer than the South African buildings continues, and the New Zealand building even gains ground on the C2 (Museum) mainly because of the increase caused by the increase in fire alarm system from a Type 3 manual fire alarm to an automatic smoke detection system (Type 4) which results in a net increase of + 0.235, with the usual trade-offs in travel distances.

CL 2: Double Storey, (<4m) Occupant load greater than 1000 People

As before, an occupant load of 1200 people is arbitrarily chosen for use in this category. The total fire safety features scores remains fairly constant, except for the small decrease attributed to the reduction in building use score as the occupant load increases, with New Zealand buildings generally being safer than the South African buildings (except for C2 Museum).

New Zealand buildings have a total score decrease of (- 0.21). This is primarily caused by the requirement for the installation of an automatic wet pipe sprinkler system (+ 0.3565) water supply (+ 0.038) but which is offset by the reductions in: fire rating (-0.3008), structural fire endurance rating (- 0.0962), dead-end open path travel distance (- 0.0198), total open path (- 0.0198) and surface finishes in occupied spaces (- 0.0908).

7.6.3. CS/CL 2: Medium Height (10 to < 25m)

The comparative fire safety index scores for medium height buildings in the CS/CL purpose groups are shown in Figure 14 – CS/CL 2: Medium Height (10 to < 25m). The primary reasons for the differences in the scoring for each country are identified in the following sections.

CS 2: Medium Height (10m to <25m), Occupant load less than 50 People

In this category CS 2 purpose group buildings with an escape height in the range from 10m to < 25 m (3 storeys to 10 storeys) and an occupant load of less than 50 people the New Zealand buildings have a higher fire safety index score than South African buildings. For New Zealand buildings the higher fire safety index score compared to the South African buildings is mainly attributed to: the higher Structural fire endurance rating (+ 0.3848) and a Type 4

fire alarm system (smoke detectors) (+ 0.588) and a direct connection to the Fire Service (+ 0.133) being requirements for New Zealand buildings. Once again, some of the increases gained through having a Type 4 fire alarm system are offset against the increased maximum permissible travel distances. It is noted that the A1 & A2 and C2 South African buildings require the installation of a manual fire alarm system (+ 0.235).

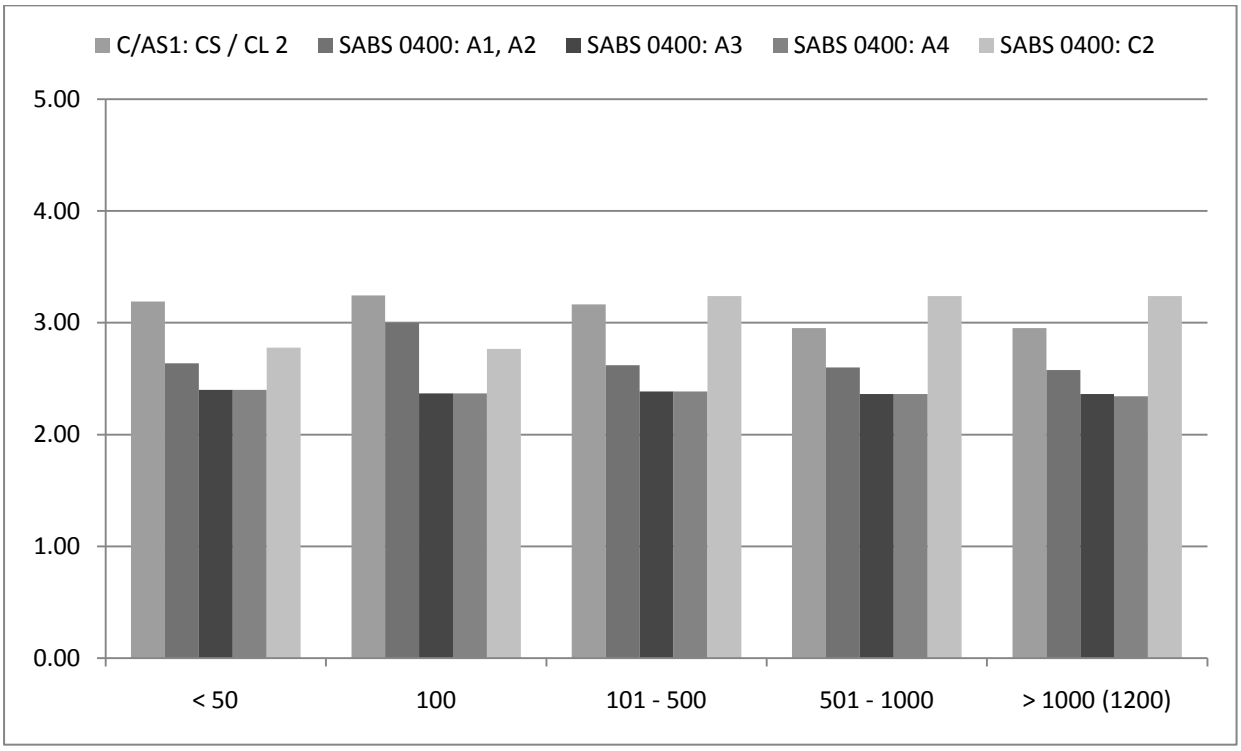

Figure 14 – CS/CL 2: Medium Height (10 to < 25m)

CS 2: Medium Height (10m to <25m), Occupant load less than 100 People

For this category of buildings with an escape height of between 10 m and 25 m and an occupant load of 100 people, a similar result occurs as for the previous section which discussed the 50 person occupant load scenario; with New Zealand buildings again having a similarly higher fire safety index score than the South African buildings. The reasons for the New Zealand buildings outscoring South African buildings are much the same as for the previous section and this report will not comment any further for this occupant load category.

CL 2: Medium Height (10m to <25m), Occupant load greater than 100 and up to 500 People

When the building occupant load increases into the range of above 100 people up to 500 people the New Zealand buildings continue to out-score the New Zealand buildings. It is, however, noticeable that the fire safety index score for the South African C2 (Museum) is almost the same as the CL 2 buildings, (2.478 : 2.536) as the occupant load has caused the floor area required to maintain that occupant load to exceed the limits which trigger the requirement for automatic fire sprinklers. This requirement for an automatic fire sprinkler system increases the score by + 0.3565 for a wet pipe sprinkler system as well as a dual superior water supply (+ 0.095). There are no trade-offs permitted in terms of increased travel distances when either automatic fire sprinklers are installed. A trade-off is, however, permitted in terms of reduced requirements for the surface finishes of occupied spaces.

CL 2: Medium Height (10m to <25m), Occupant load greater than 500 and up to 1000 People

Except for the small decrease attributed to the reduction in building use score as the occupant load increases both sets of buildings in the occupant load range from 501 occupants up to 1000 occupants, the fire safety features score remain similar to the previous occupant load category with New Zealand buildings again being ranked as safer than the South African buildings, except for C2 (Museum).

CL 2: Medium Height (10m to <25m), Occupant load greater than 1000 People

Once again for this occupant load category, an occupant load of 1200 people is arbitrarily taken as certain calculations are dependent on a reasonably exact occupant number.
For the scores for this occupant load category there are again minor changes primarily caused by the decrease in building use score as the occupant load increases. The overall fire safety index differences remain the same as for the previous occupant load category.

7.6.4. CS/CL 2: High Rise Buildings (> 33 m)

Figure 15 – CS/CL 2: 34m to < 46m, shows the comparative fire safety index scoring for high rise buildings in the CS/CL purpose groups. The main contributors to the differences in the scoring for both countries are identified in the following sections.

CS 2: High Rise Buildings (> 33m), Occupant load less than 50 People

For this category of high rise buildings, with an escape height of more than 33 metres and an occupant load of 50 people all South African buildings have a higher fire safety index score than the comparative New Zealand buildings. This is attributed to the fact that all of the South African buildings are required to have an automatic fire sprinkler system installed. While New Zealand buildings of this height also require automatic fire sprinklers, the gain in attribute score is always offset against the permitted trade-offs (primarily increased maximum permissible travel distances). Other fire safety features that contribute positively to this difference in score in favour of the South African buildings are: Firecell Rating (+ 0.15) and Type 4 Fire Alarm (+ 0.353).

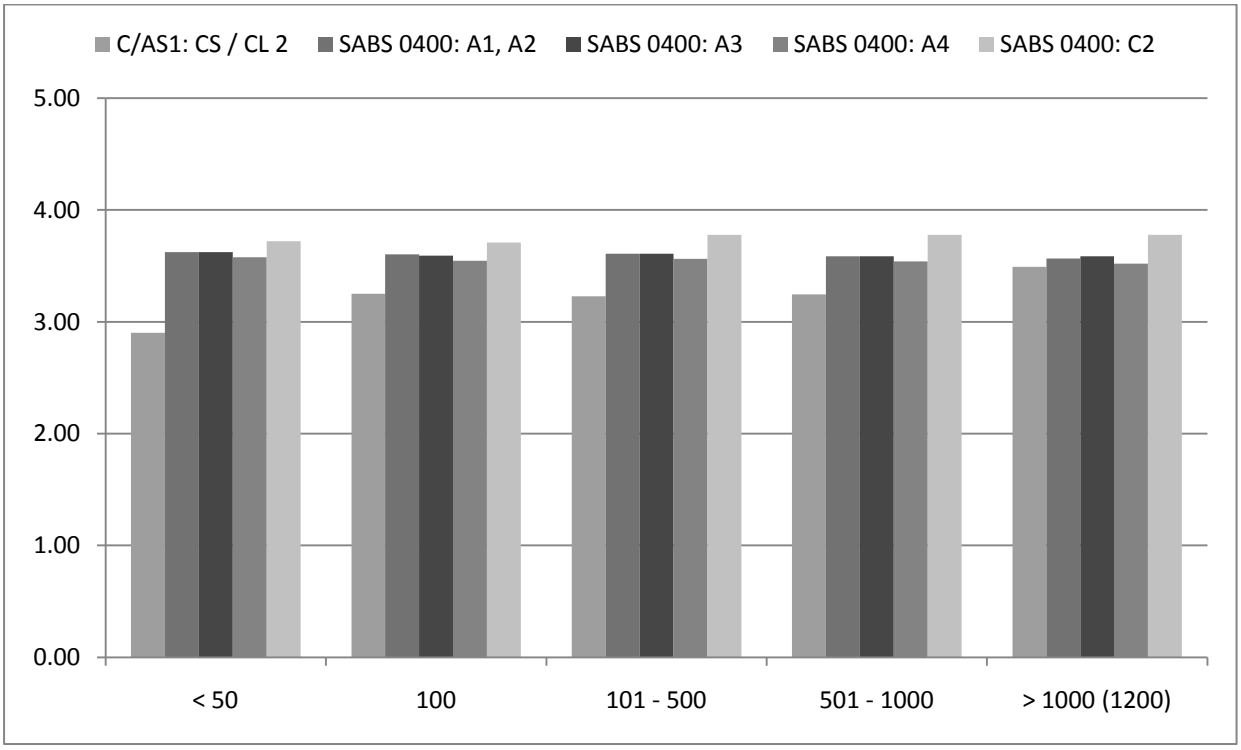

Figure 15 – CS/CL 2: 34m to < 46m

CS 2: High Rise Buildings (> 33m), Occupant load less than 100 People

The South African buildings continue their trend of outscoring the New Zealand buildings in approximately the same ratio as for the previous category for less than 50 people, and no further comment is necessary.

CL 2: High Rise Buildings (> 33m), Occupant load greater than 100 and up to 500 People

Once the occupant load of the building moves into the occupant load range of above 100 people up to 500 people the South African buildings fire safety index still out-score the New Zealand buildings, and this report will not make any further comment in this area.

CL 2: High Rise Buildings (> 33m), Occupant load 501 up to 1000 People

For this category of buildings in both countries the fire safety feature remain relatively unchanged and there bar for the small decreases attributed to the reduction in building use score as the occupant load increases, and South African buildings remain with higher overall scores than the New Zealand buildings.

CL 2: High Rise Buildings (> 33m), Occupant load greater than 1000 People

An occupant load of 1200 people is again used for this category. The scores changes in this occupant load category are again minor decreases caused by the decrease in building use score as the occupant load increases. The South African buildings still have a higher overall fire safety index score than the equivalent New Zealand C/AS1 compliant buildings.

7.7. Crowd Activity Occupancies (CS/CL 2)

In this category of buildings, the South African C2 (Museum) buildings have a slightly higher building use score by virtue of the lower fire hazard category attributed. This has the effect of raising the total fire safety features score and therefore these buildings are considered to be outliers. Consideration was given to assessing these buildings in another grouping, but because of the type of occupants who could be expected to frequent this type of building it was decided to continue with the assessment in this category. Therefore for this category of South African buildings the score for the C2 (Museum) buildings are discounted from further analysis.

For Single Storey buildings, for the three occupant load categories < 50, < 100 and < 500 people the results are fairly evenly split, with no significant differences in the fire safety of each country's buildings. Once the occupant load exceeds 500 people New Zealand buildings are considered to be safer with slightly higher scores than the South African buildings.

For all New Zealand buildings in the Double Storey height range the fire safety index scores are higher than the South African buildings.

In the height range 10 to < 25 m, the New Zealand buildings again have higher fire safety index scores than the South African buildings and the New Zealand buildings are safer than South African buildings.

Once the building height is above 34 m, the situation is reversed with all South African buildings achieving a higher fire safety index score than New Zealand buildings.

8. MERCANTILE TYPE OCCUPANCIES (LOW / MODERATE FIRE HAZARD CATEGORY CM)

8.1. General

This type of Crowd occupancy is a combination of working type occupancies and crowd type spaces. The majority of occupants are mainly “Awake” but are not necessarily “Aware”. Many of the occupants can be considered to be familiar with the premises by virtue of being employed in the building or by virtue of regular visits to the building for shopping or social purposes. Occupants of the building, even staff in many instances, do not have any concept of the building layout with regard to escape routes and behind the scenes features. In the event of an emergency human nature dictates that most people will endeavour to leave the building by way of the route that they used to come in or via some other route with which they are familiar. In addition, social cohesion and groups come into play, especially with family groups, where a mother may not want to leave the building until she has re-united with family members.

Although these premises may carry out fire evacuation drills, it is unlikely that members of the public would experience more than one such drill and possibly never be involved in one. In addition these kinds of buildings are also often occupied at night or during the hours of darkness which increases the spatial disorientation of participants. Occupants may also be under the influence of alcohol, medication or other drugs and might not have any reasonable level of comprehension and understanding. The occupants cannot be considered to be under any form of supervision. There may also be larger numbers of people with physical and/or intellectual disabilities who may need assistance in the event of an emergency than may be typically found in, for example, working type occupancies.

These matters in some ways influence the overall risk and levels of safety, however they are considered to be beyond the scope of this report, and in line with previous sections, this report will only assess matters which can be measured when the buildings are constructed in compliance with the relevant acceptable solution or deemed to satisfy rules.

8.2. Purpose Groups and Fire Hazard Categories

For this section of the comparisons the purpose group is CM (Crowd Mercantile). The fire hazard category is usually FHC 2, but in some instances a Fire Hazard Category of 4 is used.

This normally occurs when combustible goods are high racked such as in some large supermarket discount chain type operations and when there are large storage areas. The Fire Hazard Category of 4 is used in the case of the South African F3 (Wholesalers Store). Using a higher Fire Hazard Category also adopts a conservative approach, as a lower Attribute Score is used and a lower building use score is obtained.

From the breakdown of the occupancy or building classifications applicable to this section from SANS 10400 the following classes of occupancy are compared to the C/AS1 CM 2 and CM 4 purpose groups and are shown in Table 11 – Mercantile Crowd Activity Occupancies:

New Zealand	**South Africa**
CM 2	F1 – Large Shop
CM 2	F2 – Small Shop
CM 4	F3 – Wholesalers Store
CM 2	C1 – Exhibition Hall

Table 11 – Mercantile Crowd Activity Occupancies

8.3. Firecell Size – Maximum Division Area

For South African buildings the maximum division area size of a firecell is restricted by Table 3 of Part T of SANS 10400. (Refer to Appendix G – SANS 10400 – Part T, Table 3: Maximum Division Area, m^2 on page 152 of this report). For the South African C1 (Exhibition Hall) the firecell division floor area limit is 5000 m^2 where no fixed automatic fire extinguishment system (typically sprinklers) is installed. Where a fixed automatic fire extinguishment system (sprinklers) is installed in a single storey building the fire cell division size is unlimited, and in buildings two storeys and over the fire cell division size is restricted to a maximum area of 10000 m^2. For the other mercantile type purpose groups F1 & F2 (Large Shop & Small Shop) and F3 (Wholesalers Store) the firecell division floor area limit is 2500 m^2 where no fixed automatic fire extinguishment system (sprinklers) is installed. In a single storey building with fixed automatic fire extinguishment system (sprinklers) the fire cell division size is unlimited and for buildings two storeys and over the fire cell division size is restricted to a maximum area of 5000 m^2.

In New Zealand buildings the building height occupant loading of some of the scoring for this section triggers the requirement for sprinklers to be installed for example when the New Zealand CM buildings of with an escape height of over 34 m, also when the occupant load is above 500 people sprinklers are required. (Refer to Appendix K – C/AS1 – Table 4.1/3: Fire Safety Precautions: (501 to 1000 people) on page 156 of this report).

8.4. Fire Safety Index Results

The Fire Safety Index score for the Mercantile Purpose Group buildings are calculated using spreadsheets which are attached as Appendices. These start with Appendix BD – Fire Safety Index Calculations – PG: CM (0m, ≤ 50 occupants on page 257 and continue through to Appendix BM – Fire Safety Index Calculations – PG: CM (≤ 4m, ≤ 1200 occupants. Fire Safety Index scores for the other building heights have been calculated on separate spreadsheets which are not included in the appendices. The results of the fire safety index calculations for this purpose group are shown in Table 12 – Fire Safety Index: Mercantile Crowd Purpose Groups.

Height	**Building Classification**	**Occupant Number**				
		< 50	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**
0 m	C/AS1: CM 2	1.65	1.88	2.07	2.33	2.53
	SANS 10400: F1	1.84	3.09	3.52	3.21	3.49
	SANS 10400: F3	2.13	2.32	3.31	3.02	3.29
	SANS 10400: C1	2.44	2.61	2.71	3.47	3.45
< 4 m	**C/AS1: CM 2**	2.46	2.71	2.42	2.50	2.83
	SANS 10400: F1	2.33	3.26	3.67	3.52	3.67
	SANS 10400: F3	2.47	2.47	3.44	3.45	3.45
	SANS 10400: C1	2.78	2.79	2.86	3.62	3.62
4 m to 10 m	**C/AS1: CM 2**	3.06	3.08	2.71	2.68	3.02
	SANS 10400: F1	2.50	3.26	3.67	3.67	3.67
	SANS 10400: F3	2.47	2.47	3.44	3.45	3.45
	SANS 10400: C1	2.79	2.79	3.27	3.62	3.62
10 m to	**C/AS1: CM 2**	3.03	3.09	2.72	2.95	3.03

Height	Building Classification	Occupant Number				
		< 50	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**
25 m	SANS 10400: F1	2.45	3.20	3.60	3.60	3.60
	SANS 10400: F3	2.42	2.40	3.37	3.38	3.38
	SANS 10400: C1	2.74	2.72	3.20	3.55	3.55
25 m to 34 m	**C/AS1: CM 2**	3.01	3.00	3.00	3.31	3.31
	SANS 10400: F1	2.38	3.13	3.54	3.54	3.54
	SANS 10400: F3	2.36	2.34	3.31	3.32	3.32
	SANS 10400: C1	2.68	2.65	3.14	3.49	3.49
34 m to 46 m	**C/AS1: CM 2**	3.25	3.25	3.31	3.31	3.30
	SANS 10400: F1	3.63	3.79	3.79	3.79	3.79
	SANS 10400: F3	3.60	3.58	3.56	3.57	3.57
	SANS 10400: C1	3.68	3.66	3.74	3.74	3.74

Table 12 – Fire Safety Index: Mercantile Crowd Purpose Groups

8.5. Fire Safety Index Comparisons (CM 2/4)

8.5.1. CM 2/4: Single Storey (0m)

The comparative fire safety index scores for a single level building in the CM purpose groups are shown in Figure 16 – CM 2: Single Storey (0m). The major reasons for the differences in the scoring for the various buildings in each country are discussed in the following sections.

CM 2/4: Single Storey, Occupant load less than 50 People

For a Single Storey Building (Escape Height 0m) in the CM 2/4 purpose group all South African buildings have a higher fire safety index score when the occupant load is less than 50 people and the results show no similarities or consistency across the different building types. In the first instance the South African buildings all have a higher Firecell rating requirement (+ 0.3008; + 0.6016; + 0.6016), the requirement for two escape routes (+ 0.0392) and a minimum width of 1200mm (+ 0.0196). The F2 (Small Shop) buildings only require a Structural fire endurance of 30 minutes (+ 0.0962), while the other two require 60 minute ratings (+ 0.1924). The C1 (Exhibition Hall) requires a manual fire alarm system (+ 0.235). For the F3 (Wholesalers Store) automatic natural smoke ventilation is also required (+ 0.080).

New Zealand buildings have no Firecell rating (0), only require a single escape route (0) and have an escape route width of < 1000mm (0), but the requirement for a 60 minute Structural fire endurance of 60 minutes reduces the difference in the buildings (+ 0.1924).

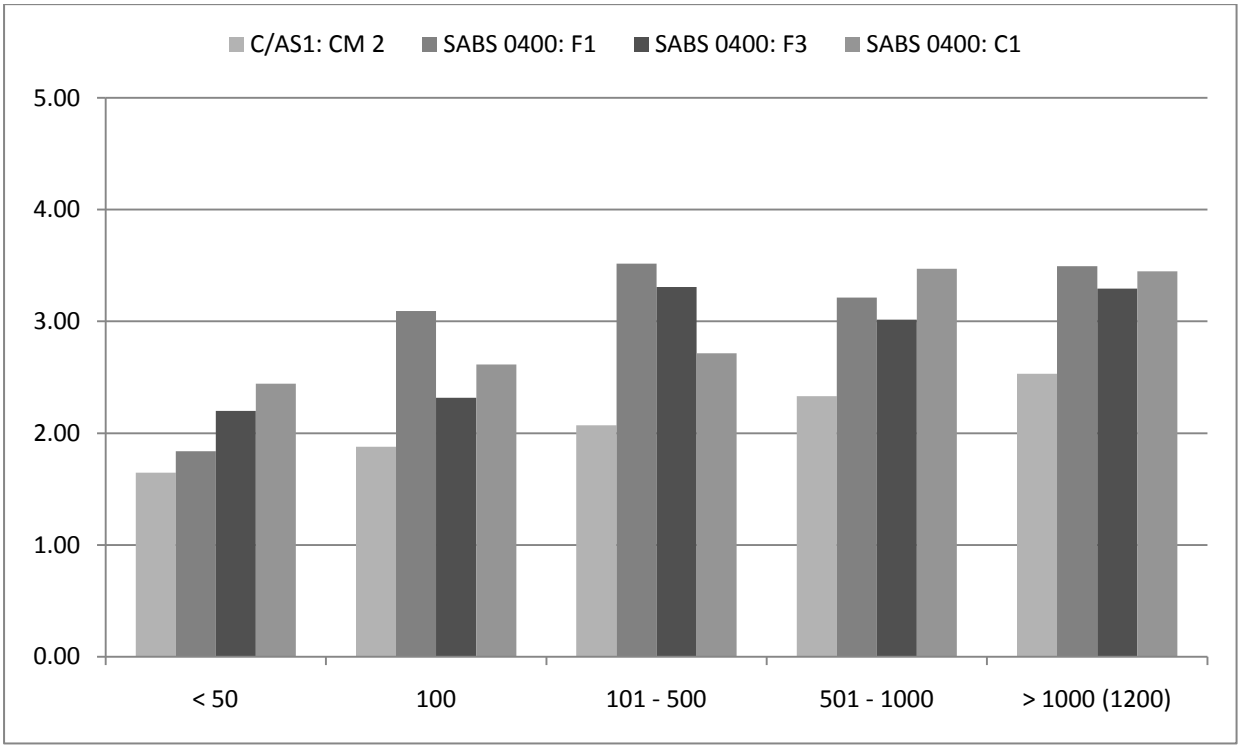

Figure 16 – CM 2: Single Storey (0m)

CM 2/4: Single Storey, Occupant load less than 100 People

For Single Storey Buildings with an occupant load of 100 people, there is no significant difference in the fire safety index scores for the New Zealand building and for the South African F3 (Wholesalers Store) and C1 (Exhibition Hall). The South African F2 (Small Shop) now becomes a large shop (F1) and also increases noticeably in total fire safety index score when compared to similar buildings with an occupant load of less than 50 people. This increase can be attributed to: the increase in firecell rating from 30 minutes to 60 minutes (+ 0.3008), the requirement for an automatic fire detection system with smoke detection (+ 0.588), HVAC automatic shut-down (+ 0.184), and automatic natural smoke ventilation (+ 0.080)

CM 2/4: Single Storey, Occupant load greater than 100 and up to 500 People

When the building occupant load increases into the range of above 100 people up to 500 people there is again a noticeable difference in the fire safety index scoring, with South African buildings substantially out-scoring New Zealand buildings. The main reason for this is that the occupant loads for the F1 (Large Shop) and F3 (Wholesalers Store) has caused the floor area required to maintain that occupant load to exceed the limits which trigger the requirement for automatic fire sprinklers. As is the case for the other South African buildings the requirement for automatic fire sprinklers to be installed increases the score for a wet pipe sprinkler system (+ 0.3565) as well as dual superior water supply (+ 0.095). The requirement for a smoke detection system increases the score by (+ 0.588). Again, there are no trade-offs permitted in terms of increased travel distances when either automatic smoke detection or automatic fire sprinklers are installed. For the F3 (Wholesalers Store) the triggering of the requirement for sprinklers means a substantial jump in score, from 3.26 to 3.67. A trade-off is permitted in terms of reduced requirements for the surface finishes of occupied spaces.

For the New Zealand buildings there is a slight increase because Type 3 heat detectors are required, but this is again off-set against the increased permissible open path travel distances.

CM 2/4: Single Storey, Occupant load greater than 500 and up to 1000 People

As the occupant load increases to the range of 501 to 1000 occupants the South African fire safety features remains fairly constant, except for the small decrease attributed to the reduction in building use score as the occupant load increases. The exception to this is the C1 (Exhibition Hall) which shows an increase attributed to the requirements for both automatic wet pipe sprinkler system and automatic fire (smoke) detection.

The increase in the total for the building fire safety index score for New Zealand buildings is primarily influenced by the upgrading from Type 3 fire alarm system to a Type 4 automatic fire alarm system with smoke detection and has a net increase of + 0.353, but this is again off-set against the increased permissible open path travel distances.

CM 2/4: Single Storey, Occupant load greater than 1000 People

For this occupant load category, an occupant load of 1200 people is arbitrarily taken as certain calculations are dependent on a reasonably exact occupant number. There are again minor changes in the scoring for the buildings when the occupant load exceeds 1000 people.

The New Zealand buildings now also require automatic fire sprinklers, the benefits of which are again offset against increased permitted travel distances. These changes are not significantly different to warrant any further comment for these buildings.

8.5.2. CM 2/4: Double Storey (Escape Height <4m)

The comparative fire safety index scores for double storey buildings in the CM purpose groups are shown in Figure 17 – CM 2/4: Double Story (< 4m). The reasons for any large differences in scoring across each country are identified in the following sections.

CM 2/4: Double Storey, Occupant load less than 50 People

For Double Storey Buildings (Escape Height less than 4.0m) in the CM 2/4 purpose group when the occupant load is in the category of less than 50 people the New Zealand buildings have a higher fire safety index score than the F2 (Small Shop) and the same score as the F3 (Wholesalers Store). This increase in fire safety index score for New Zealand buildings is substantially due to the 60 minute Firecell rating requirement (+ 0.6016), and a net increase in the Structural fire endurance rating (+ 0.1924).

For South African buildings the only noticeable change is for the C1 (Exhibition Hall) which ranks slightly above the New Zealand CM, primarily because of the 90 minute Firecell rating (+ 0.0752) and the installation of a manual fire alarm system (+ 0.235) and automatic HVAC shutdown (+ 0.184).

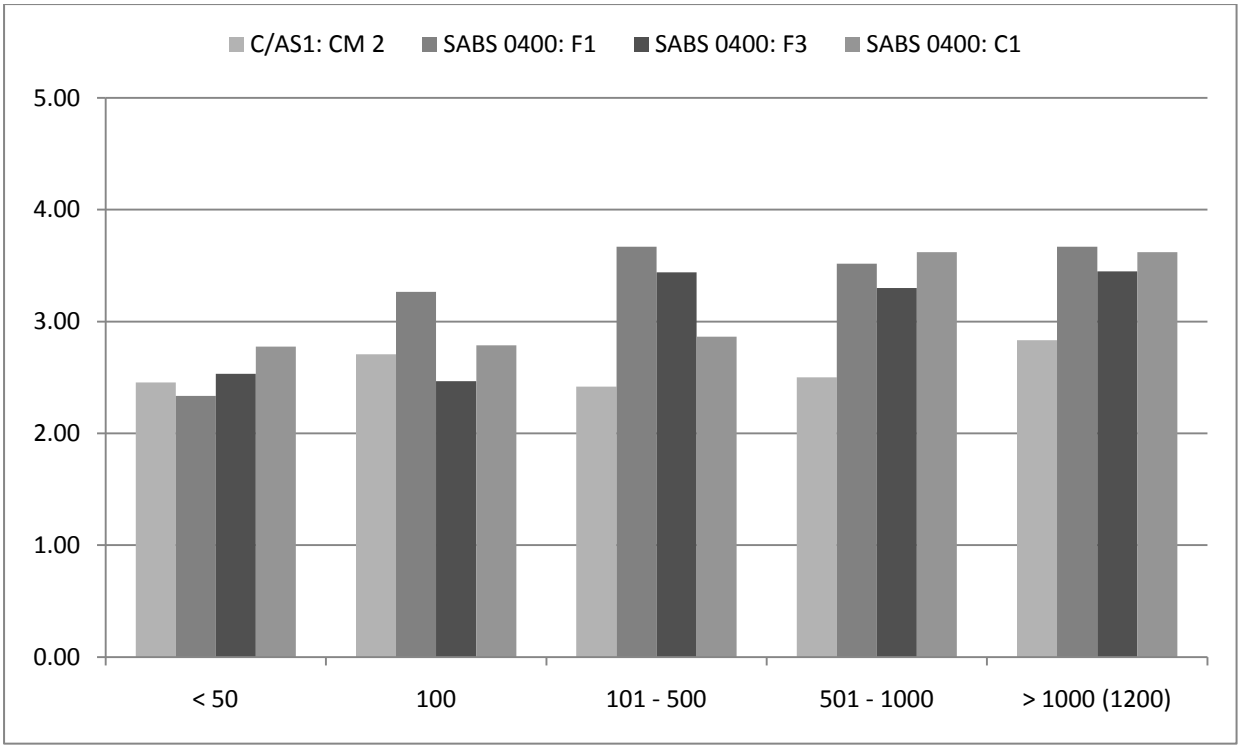

Figure 17 – CM 2/4: Double Story (< 4m)

CM 2/4: Double Storey, (<4m) Occupant load less than 100 People

For Double Storey Buildings (escape height < 4.0m) with an occupant load of less than 100 people in the CM 2/4 purpose group New Zealand buildings have a higher fire safety index score than C1 (Exhibition Hall) and F3 (Wholesalers Store). The increase for the CM buildings is primarily brought about by the requirement for a manual fire alarm system (+ 0.235) and two escape routes (+ 0.0392).

The change from Small Shop (F2) to Large Shop (F1) brings the requirement for a smoke detection system (+ 0.588), automatic natural smoke ventilation (+ 0.184), internal fire hydrant system (+ 0.0221). As before the South African Deemed-to-satisfy document does not permit trade-offs for the installation of a fire detection system.

CM 2/4: Double Storey, (<4m) Occupant load greater than 100 and up to 500 People

Once the occupant load of the building moves into the occupant load range of above 100 people up to 500 people the fire safety index score for all South African buildings again out-scores New Zealand buildings. Yet again the reasons for the increase in the fire safety index scoring for South African buildings are the additional requirements for automatic fire

sprinklers (+ 0.3565) and water supply (+ 0.095), with the requirements for sprinklers again being brought about by the increase in floor area to support the higher occupant load, which is above the maximum floor area threshold for unsprinklered fire cells. For the F3 (Wholesalers Store) the occupant load cap also comes into play, with the load being capped at 250 people. As is the case with other South African buildings no trade-offs are permitted by virtue of increased travel distances when either automatic smoke detection or automatic fire sprinklers are installed. The only trade-off is for reduced surface finishes required for occupied spaces.

CM 2/4: Double Storey, (<4m) Occupant load greater than 500 and up to 1000 People

Except for the small decrease attributed to the reduction in building use score as the occupant load increases to the occupant load range from 501 occupants up to 1000 occupants the fire safety features score for F1 and F3 are constant. The C1 (Exhibition Hall) show a noticeable increase because smoke detection and automatic fire sprinklers are required. The South African buildings are all noticeably safer than the New Zealand ones at this occupant load.

CM 2/4: Double Storey, (<4m) Occupant load greater than 1000 People

As for the single storey buildings an occupant load of 1200 people is again arbitrarily used for this category. As only minor changes occur to the total fire safety index score across buildings in both countries when the building occupant load is set at 1200 people and there are no significant differences in score, this section does not warrant further comment.

8.5.3. CM 2/4: Medium Height Buildings (10m to < 25m)

The comparative fire safety index scores for medium rise buildings in the Crowd Mercantile (CM) purpose groups are shown in Figure 18 – CM 2/4: 10m to < 25m. Major reasons for the differences in the scoring for the buildings in each country are indicated in the following sections.

CM 2/4: Medium Height (10m to <25m), Occupant load less than 50 People

For CM 2/4 purpose group buildings with an escape height in the range from 10m to < 25 m (3 storeys to 10 storeys) and an occupant load of less than 50 people the New Zealand buildings have a higher fire safety index score (3.0) than South African buildings (F2 – 2.24; F3 – 2.45; and C1 – 2.7). The higher fire safety index score for New Zealand buildings over

South African buildings is mainly attributed to the Structural fire endurance rating having a requirement of 120 minutes compared to the 30 minutes and 60 minutes for the South African buildings, and a Type 3 fire alarm system (+ 0.3528) with a direct connection to the fire service (+ 0.133) being a requirement for the New Zealand buildings with an increase for the alarm type which is offset against the increased travel distances permitted.

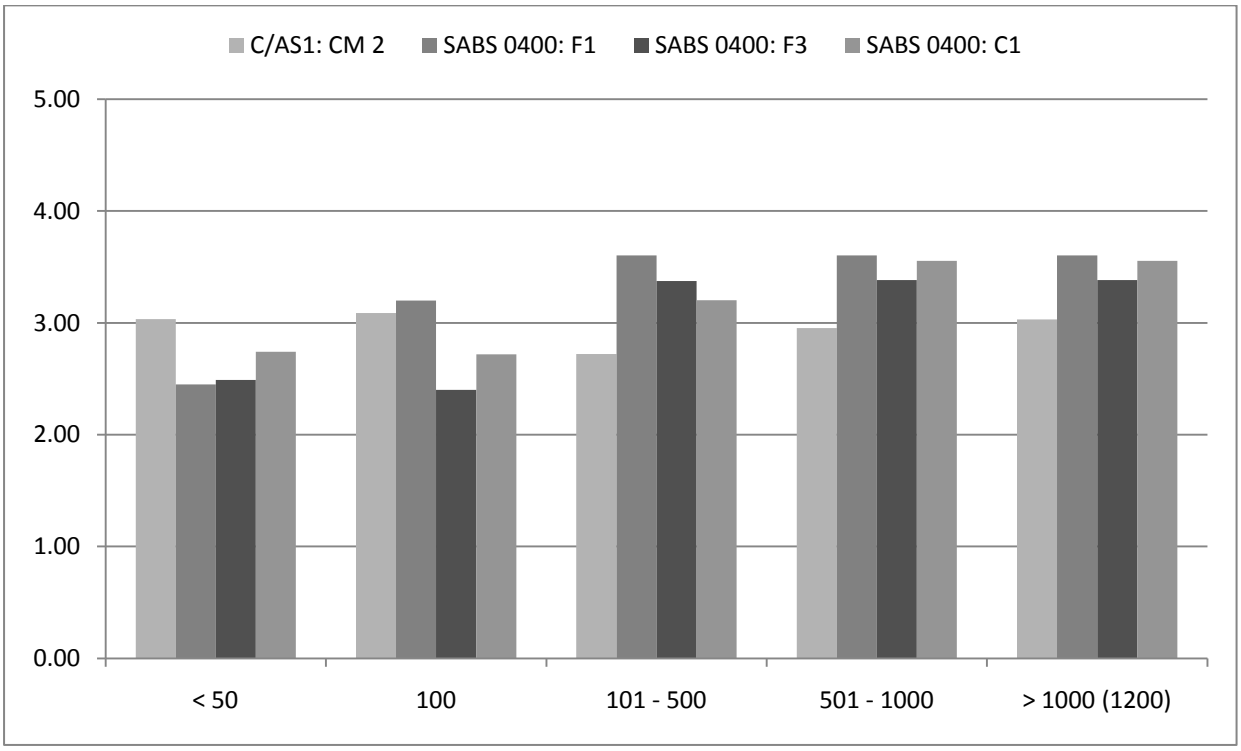

Figure 18 – CM 2/4: 10m to < 25m

CM 2/4: Medium Height (10m to <25m), Occupant load less than 100 People

When this category of buildings with an escape height of between 10 m and 25 m has an occupant load of 100 people, similar patterns appear as for the previous section which discussed the 50 person occupant load scenario; with New Zealand buildings again having a similarly higher fire safety index score than the South African buildings, except for the F1 (Large Shop). The F1 (Large Shop) has a notable increase in fire safety index score from the previous score for the F2 (Small Shop) from 2.45 to 3.20. This is largely caused by the requirements for an automatic fire alarm with smoke detection (+ 0.588) an increase in the firecell rating from 30 minutes to 60 minutes (+ 0.0962), the requirement for the provision of emergency lighting (+ 0.0255) and automatic natural smoke ventilation (+ 0.080). The reasons for the New Zealand buildings outscoring South African buildings are much the same

as for the previous section and this report will not comment any further for this occupant load category.

CM 2/4: Medium Height (10m to <25m), Occupant load greater than 100 and up to 500 People

When the building occupant load increases into the range of above 100 people up to 500 people there is again a noticeable difference in the fire safety index scoring, with all South African buildings again substantially out-scoring New Zealand buildings. As before, the main reason for this is that the occupant load has caused the floor area required to maintain that occupant load to exceed the limits which trigger the requirement for automatic fire sprinklers. For the F3 (Wholesalers Store) the installation of Type 4 smoke detectors also comes into play. In the case of South African buildings the requirement for the installation of a smoke detection system increases the score by + 0.588 and the requirement to install an automatic fire sprinkler system increases the score by + 0.3565 for a wet pipe sprinkler system and a dual superior water supply (+ 0.095). There are no trade-offs permitted in terms of increased travel distances when either automatic smoke detection or automatic fire sprinklers are installed. A trade-off is, however, permitted in terms of reduced requirements for the surface finishes of occupied spaces. This is the same for New Zealand buildings and therefore there is no net difference in scoring between the buildings.

For the New Zealand buildings, automatic fire sprinklers are also required for these occupant loads and building heights. The installation of an automatic fire sprinkler system again increases the fire safety features scoring, but the increase is again offset by the reduction in attribute scores attained because of the trade-offs permitted by virtue of increased maximum travel distances.

CM 2/4: Medium Height (10m to <25m), Occupant load greater than 500 and up to 1000 People

As the occupant load increases to the range of 501 to 1000 occupants the South African fire safety features remains fairly constant, except for the small decrease attributed to the reduction in building use score as the occupant load increases. South African buildings remain with higher overall scores than the New Zealand buildings.

CM 2/4: Medium Height (10m to <25m), Occupant load greater than 1000 People

The occupant load is arbitrarily set at 1200 people as certain calculations are dependant on a reasonably exact occupant number. For the scores for this occupant load category there are again minor changes primarily caused by the decrease in building use score as the occupant load increases. Apart from these areas there are no other significant items which require any discussion.

8.5.4. CM 2/4: High Rise Buildings (> 33m)

Figure 19 – CM 2/4: 34m to < 46m, shows the comparative fire safety index scoring for high rise buildings in the CM purpose groups. The main contributors to the differences in the scoring for the buildings in each country are identified in the following sections.

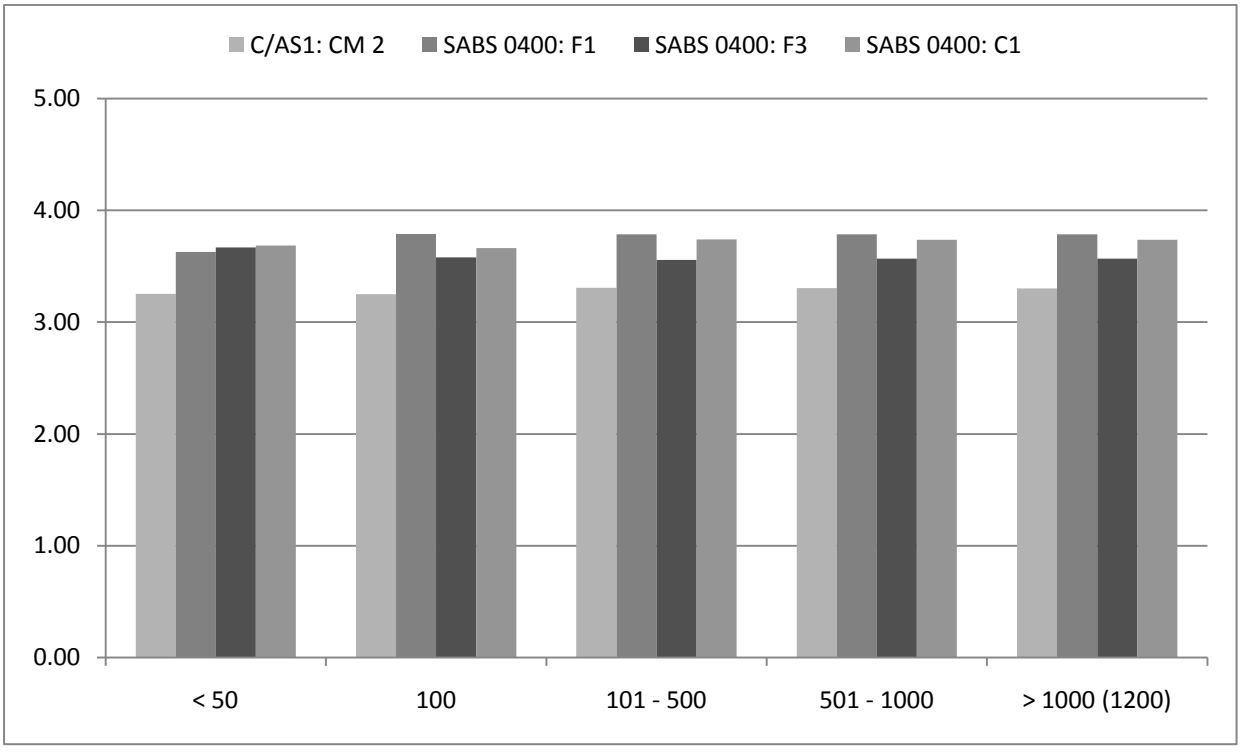

Figure 19 – CM 2/4: 34m to < 46m

CM 2/4: High Rise Buildings (> 33m), Occupant load less than 50 People

For High rise buildings with an escape height of more than 33 metres and an occupant load of 50 people all South African buildings have a higher fire safety index score than the comparative New Zealand buildings. This is attributed to the fact that all of the South African buildings are required to have an automatic fire sprinkler system installed. While New Zealand buildings of this height also require automatic fire sprinklers, the gain in attribute score is always offset against the permitted trade-offs (primarily increased maximum permissible travel distances).

CM 2: High Rise Buildings (> 33m), Occupant load less than 100 People

In this category of buildings the South African buildings continue their trend of outscoring the New Zealand buildings, mainly by virtue of the requirement for automatic fire sprinklers without ant trade-offs.

CM 2/4: High Rise Buildings (> 33m), Occupant load greater than 100 and up to 500 People

Once the occupant load of the building moves into the occupant load range of above 100 people up to 500 people the South African buildings fire safety index still out-score the New Zealand buildings.

CM 2/4: High Rise Buildings (> 33m), Occupant load greater than 500 and up to 1000 People

For this category of buildings in both countries the fire safety feature remain relatively unchanged bar for the small decrease attributed to the reduction in building use score as the occupant load increases. South African buildings remain with higher overall scores than the New Zealand buildings.

CM 2/4: High Rise Buildings (> 33m), Occupant load greater than 1000 People

The occupant load used for this category is again 1200 people. The scores changes in this occupant load category are again minor changes primarily caused by the decrease in building use score as the occupant load increases. The South African buildings still have a higher overall score compared to the New Zealand equivalent C/AS1 compliant buildings.

8.6. Mercantile Occupancies (CM 2/4)

For Single Storey Mercantile Type buildings all the South African buildings have a higher fire safety index score than New Zealand Buildings.

In the Double Storey height range of buildings, the two occupant loads of < 50 and < 100 are both scored higher for New Zealand buildings than South African buildings, and when the occupant load increases above 100 people the South African buildings again have higher fire safety index scores.

In the height range 10 to < 25 m, the two occupant loads of < 50 and < 100 are both safer New Zealand buildings than South African buildings, and when the occupant load increases above 100 people the South African buildings again have higher fire safety index scores.

Once the building height is above 34 m, all South African buildings achieve higher fire safety index scores than New Zealand buildings.

9. SLEEPING OCCUPANCIES (LOW FIRE HAZARD CATEGORY SA / SR)

9.1. General

Sleeping occupancies have a different type of risk compared to the other occupancy types. Firstly the buildings are designed, as the title of this section suggests, for people to be sleeping in them, so the occupants cannot be considered to be awake, nor could they be considered to be aware.

In addition people using short term accommodation (hotels, motels and the like) are not expected to be familiar with the building layout, especially in buildings which are higher than single level or are sprawling complexes. Although many accommodation type establishments have escape plans attached to the inside of bedroom doors, many also do not. The requirement for such escape plan information signage is neither a Building Code requirement in New Zealand or in South Africa. The requirement for the provision of such signage is expected to come under building evacuation regulations or other local regulations and as such is not considered any further in this report.

Buildings used for sleeping are normally more intensively used at night time and this can lead to disorientation of building occupants, especially when a fire or other emergency occurs. In addition to the expected use of the premises for sleeping purposes, and building unfamiliarity, occupants could also be under the influence of alcohol or drugs which can also affect their ability to escape from a fire even if code compliant early warning fire alarm systems are installed. While most fire alarm standards have a stated requirement for the alarm sounders to produce a required sound level at the bed-head, the standards do not necessarily address the issue of deaf patrons adequately (e.g. vibrating pillows, strobe lights etc.).

Sleeping establishments such as Hotels and Motels are also expected to cater for people with disabilities by making provision for a certain number of rooms or suites to be designed to cater for of people with disabilities. People in a sleeping environment are not under any form of building management supervision, and in addition the group or family dynamic can be a factor influencing evacuation decision making by people in the event of an emergency.

In New Zealand the fire safety and evacuation of buildings regulations [24] also impose additional requirements to ensure that evacuation drills are carried out in terms of approved evacuation schemes or procedures, however it is unlikely that most patrons would ever take

part in such a drill. In view of the above factors, management may not be aware that patrons could be deaf, using medication or be under the influence of alcohol, and even if they were aware of these limitations they may not be in a position to assist with evacuation.

When the sleeping type accommodation is longer term (residential) some of the aspects of unfamiliarity of the premises disappear, and then it becomes a case of "familiarity breeds contempt" as is evidenced by the relatively high numbers of fire deaths in residential accommodation throughout the world. The human behaviour aspects such as alcohol and drug use remain with this category and to a certain extent they can be expected to be far worse than the other factors in some societies. Factors which are also to be considered with these premises are the use of cooking and heating appliances. Other hazards are the smoker's materials, matches, candles and liquid fuels.

While they authorities responsible for writing and enacting building laws, standards and compliance documents are expected to take such factors into account when preparing the rules, they may not necessarily be able to account for every possible eventuality.

9.2. Purpose Groups and Fire Hazard Categories

For this section of the report, the purpose groups which will be assessed SA (Sleeping Accommodation) and SR (Sleeping Residential). The fire hazard category used for this section of the analysis is FHC 1 as these are the equivalent Fire Hazard Categories used in the Acceptable Solution and Deemed-to-Satisfy documents.

This author is of the opinion that assigning an assumed fire load energy density of 400 MJ/m^2 for residences should be revisited. When it is considered that residences are loaded with items such polyurethane stuffed mattresses and furniture, bedding (artificial stuffing in duvets), clothing, electronic equipment (mainly plastic materials) and other combustible materials, the FHC of 1 appears too low when it is considered that offices have a designated FHC of 2, and, by observation, have far less combustible materials. The use of a higher Fire Hazard will not affect the outcome of this comparative analysis as the Building Use Score for both countries will decrease by the same margin, but using a higher Fire Hazard Category will effectively decrease the total Fire Safety Index score, thereby reflecting the higher risk to life safety.

The equivalent South African building occupancy classes applicable to this section are shown in Table 13 – Sleeping Occupancies.

New Zealand	South Africa
SA 1	H1 – Hotel
SA 1	H2 – Dormitory
SR 1	H5 – Hospitality
SR 1	H3 – Domestic Residence

Table 13 – Sleeping Occupancies

9.3. Firecell Size – Maximum Division Area

For South African buildings, the maximum permissible division area size of a firecell is restricted by Table 3 of Part T of SANS 10400, however in reality this is not normally an issue. (Refer to Appendix G – SANS 10400 – Part T, Table 3: Maximum Division Area, m^2 on page 152 of this report). For all South African sleeping purpose occupancies, the maximum firecell division floor area limit is 2500 m^2 where no fixed automatic fire extinguishment system (typically sprinklers) is installed. Where a fixed automatic fire extinguishment system (sprinklers) is installed in a single storey building the fire cell division size is unlimited, and in buildings two storeys and over the fire cell division size is restricted to a maximum area of 5000 m^2.

Table 4.1/5 of C/AS1 restricts the maximum occupant load in a firecell in New Zealand buildings to 40 people where the firecell is not fitted with an automatic fire sprinkler system and to a maximum of 160 people in a sprinkler protected firecell. The comparisons will therefore be limited to these two occupant load categories (Refer to Appendix M – C/AS1 – Table 4.1/5: Fire Safety Precautions for Sleeping Purpose Group Firecells: (Occupant Load 40 Maximum on page 158 of this report).

9.4. Fire Safety Index Results – Sleeping Accommodation

The Fire Safety Index results for the Sleeping Accommodation type buildings are calculated using spreadsheets which are attached as Appendices. These begin from Appendix BN – Fire

Safety Index Calculations – PG: SA (0m, ≤ 40 occupants on page 283, continuing through to Appendix BQ – Fire Safety Index Calculations – PG: SA (≤ 4m, ≤ 160 occupants). Fire Safety Index scores for the other building heights have been calculated on separate spreadsheets which are not included in the appendices. The results of the fire safety index calculations for the SA (Sleeping Accommodation) purpose group are shown in Table 14.

Height	**Building Classification**	**Occupant Number**	
		40	**160**
0 m	**C/AS1: SA 1**	1.67	2.22
	SANS 10400: H1	1.85	2.04
	SANS 10400: H2	1.85	2.02
< 4 m	**C/AS1: SA 1**	2.70	2.63
	SANS 10400: H1	2.33	2.34
	SANS 10400: H2	2.08	2.07
4 m to 10 m	**C/AS1: SA 1**	2.82	2.73
	SANS 10400: H1	2.52	2.49
	SANS 10400: H2	2.41	2.37
10 m to 25 m	**C/AS1: SA 1**	2.87	2.77
	SANS 10400: H1	3.06	3.02
	SANS 10400: H2	2.95	2.91
25 m to 34 m	**C/AS1: SA 1**	2.93	2.89
	SANS 10400: H1	2.99	2.95
	SANS 10400: H2	2.89	2.84
34 m to 46 m	**C/AS1: SA 1**	3.27	3.23
	SANS 10400: H1	3.60	3.56
	SANS 10400: H2	3.65	3.61

Table 14 – Fire Safety Index: Sleeping Accommodation Purpose Groups

9.5. Fire Safety Index Comparisons (SA)

9.5.1. SA 1: Single Storey (0m)

For the Sleeping Accommodation (SA) purpose groups, the comparative fire safety index scores for a single level building are shown in Figure 20 – SA 1: Single Storey (0m). The main reasons for the differences in the scoring for each of the various buildings in each country are discussed in the following sections.

SA 1: Single Storey, Occupant load less than 40 People

For a Single Storey Building (Escape Height 0m) in the SA 1 purpose group the South African H1 (Hotel) and H2 (Dormitory) slightly out score the New Zealand buildings. The main reason for this is the firecell rating of 30 minutes for the South African buildings (+ 0.3008), compared to a firecell rating of 0 minutes for New Zealand C/AS1 buildings. New Zealand buildings regain some of this with the 60 minutes Structural Firecell Rating (+ 0.0962). Apart from this the buildings both appear equally safe, even though both appear to have relatively low total fire safety features scores when compared to the other building types evaluated in this report.

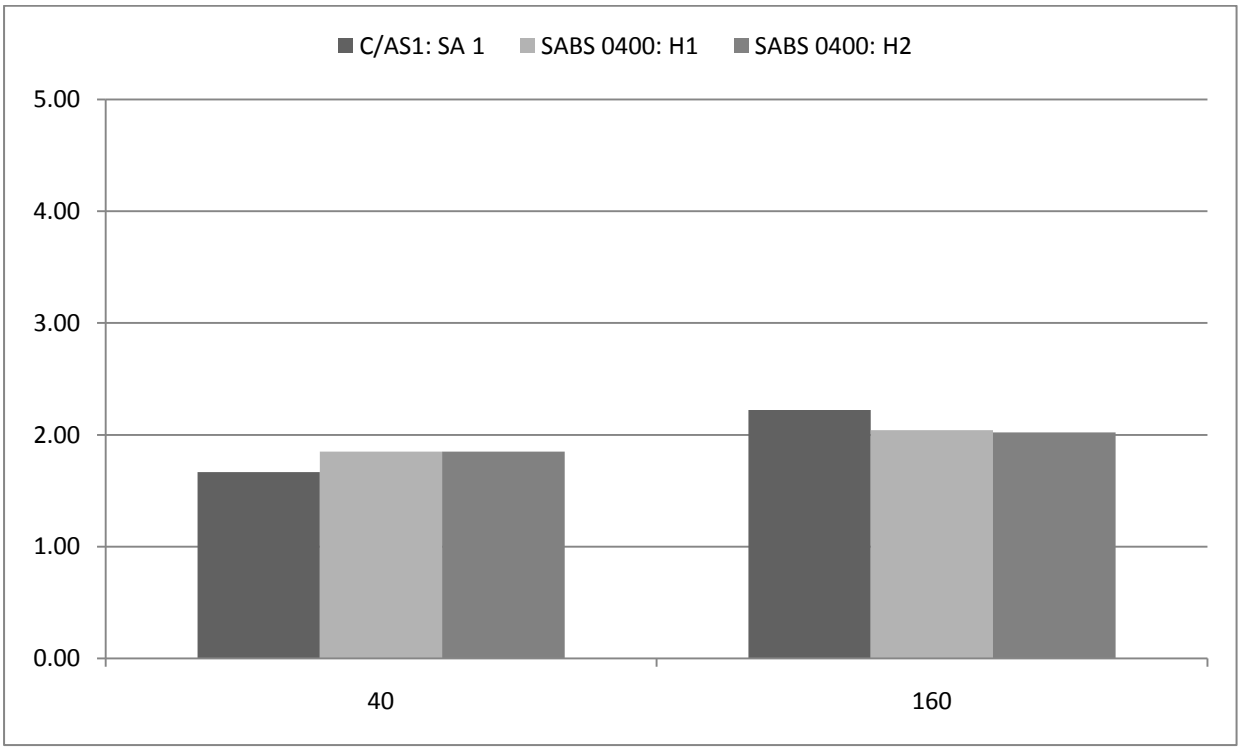

Figure 20 – SA 1: Single Storey (0m)

SA 1: Single Storey, Occupant load of 160 People

When the building occupant load increases to a maximum of 160 occupants New Zealand buildings are slightly safer than the South African ones. This is primarily caused by the requirements for an automatic fire sprinkler system, water supply and a Type 5 automatic fire alarm system. The benefits gained from these are again substantially offset by the permissible increase in travel distances.

9.5.2. SA 1: Double Storey (Escape Height <4m)

Figure 21 – SA 1: Double Storey (< 4m) shows the comparative fire safety index scoring for double storey buildings in the Sleeping Accommodation purpose groups. The main contributors to the differences in the scoring for the buildings in each country are identified in the following sections.

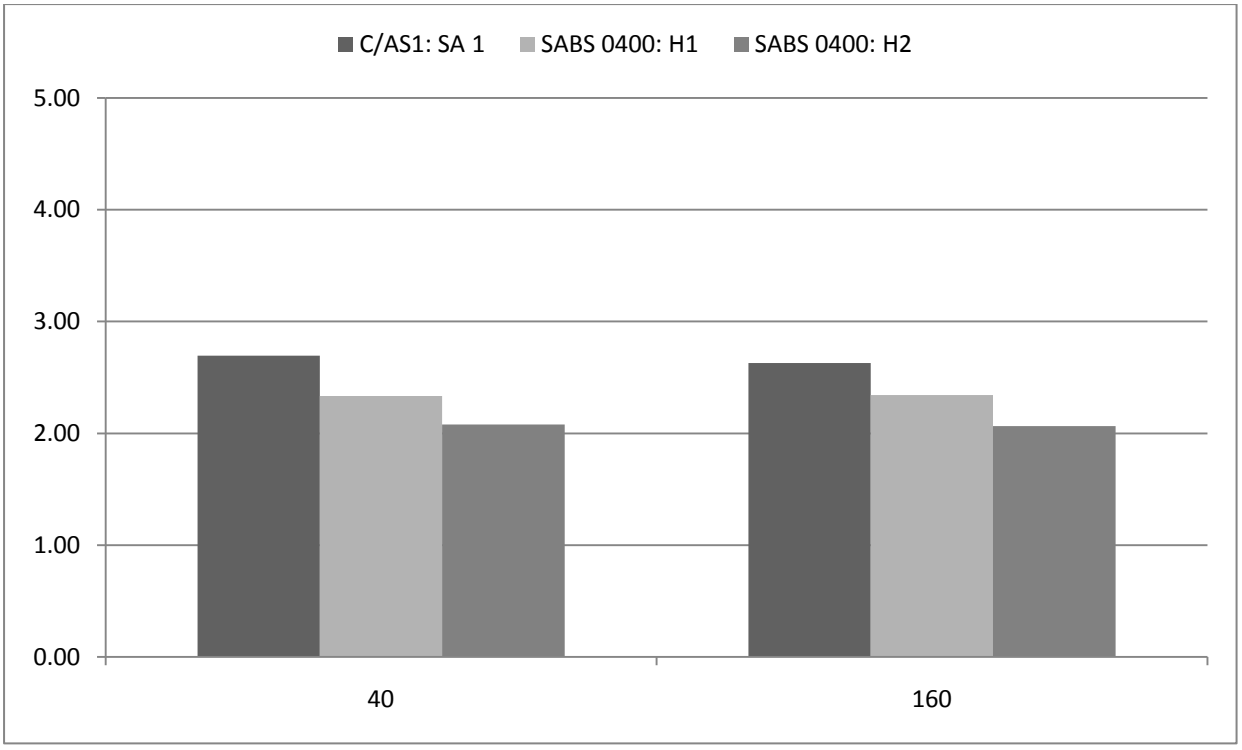

Figure 21 – SA 1: Double Storey (< 4m)

SA 1: Double Storey, Occupant load less than 40 People

For Double Storey Buildings (Escape Height less than 4.0m) in the SA 1 purpose group New Zealand buildings have a higher fire safety index score when the occupant load is in the

category of less than 40 people. The increases in fire safety index score for New Zealand building is substantially due to the 45 minute Firecell rating requirement (+ 0.4512), and a net increase in the Structural fire endurance rating (+ 0.1384) and a Type 5 alarm (+ 0.470).
For South African buildings the only noticeable change from the single storey buildings is a (+ 0.184) increase as automatic shut down of HVAC systems are required. Other requirements remain substantially unchanged.

SA 1: Double Storey, (<4m) Occupant load 160 people.

For Double Storey Buildings (escape height < 4.0m) with an occupant load of less than 160 people New Zealand buildings again have a higher fire safety index score than South African buildings. There are no significant changes from the previous height category to warrant further comment.

9.5.3. SA 1: Medium Height Buildings (10m to < 25m)

The comparative fire safety index scores for medium height buildings in the Sleeping Accommodation SA purpose groups are shown in Figure 22 – SA 1: Medium Height Buildings (10m to < 25m). The major contributory factors to the differences in the scoring for the buildings in each country are also identified.

SA 1: Medium Height (10m to <25m), Occupant load less than 40 People

For SA 1 purpose group buildings with an escape height in the range from 10m to < 25 m (3 storeys to 10 storeys) and an occupant load of less than 40 people both the New Zealand and South African buildings show very similar total fire safety index scores, with both around the 3 mark. For the South African buildings the noticeable addition to the fire safety features is the requirement for the installation of an automatic fire alarm system with smoke detection. The New Zealand buildings require a Type 5 alarm system, a direct connection to the fire service and also fire service lift control.

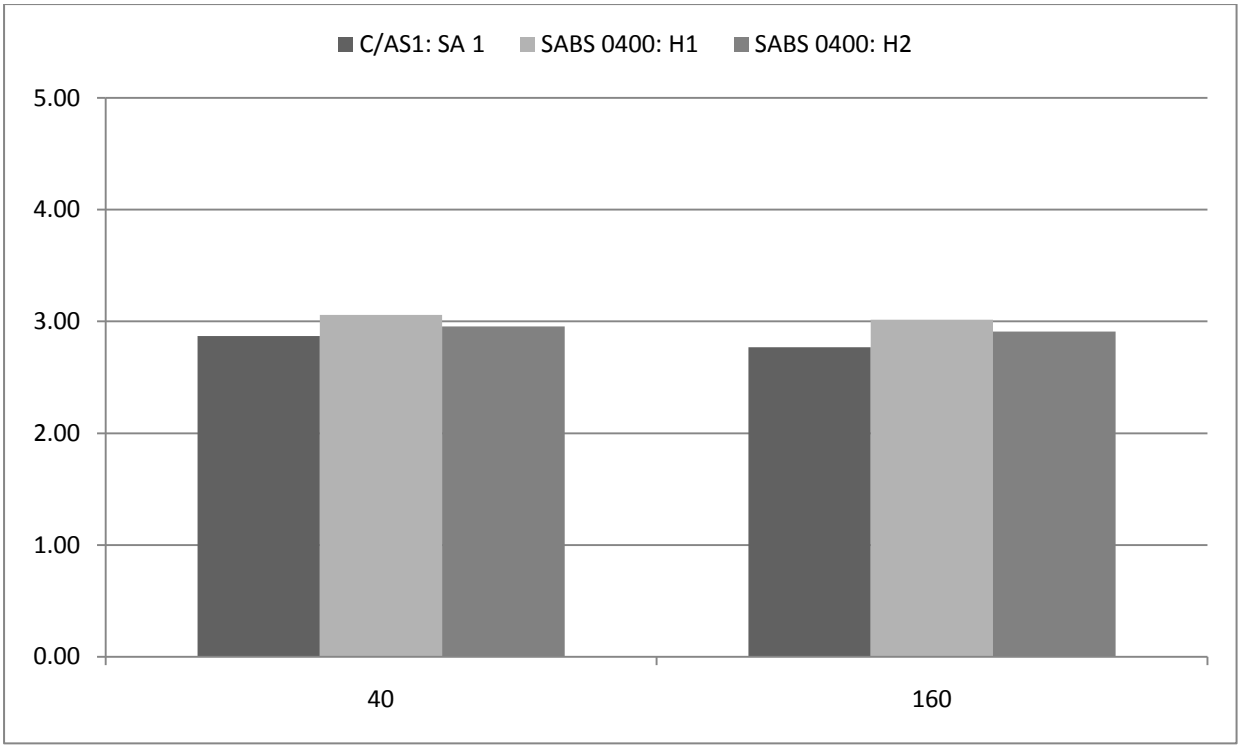

Figure 22 – SA 1: Medium Height Buildings (10m to < 25m)

SA 1: Medium Height (10m to <25m), Occupant load less than 160 People

When this category of buildings with an escape height of between 10 m and 25 m has an occupant load of 160 people, the South African buildings show a similar result as for the previous section which discussed the 40 person occupant load scenario. The New Zealand buildings are required to have an automatic fire sprinkler system installed, but the advantages gained from this are once again lost to reduced fire cell rating, reduced structural fire resistance and the increased travel distances allowed.

9.5.4. SA 1: High Rise Buildings (> 33m)

For the high rise SA (Sleeping Accommodation) buildings, the comparative fire safety index scores are shown in Figure 23 – SA 1: 34m to < 46m. The major reasons for the differences in the scoring for each of the various buildings in each country are discussed in the following sections.

SA 1: High Rise Buildings (> 33m), Occupant load less than 40 People

For High rise buildings with an escape height of more than 33 metres and an occupant load of less than 40 people both sets of building have fire safety index scores well above 3. However, all South African buildings have a higher fire safety index score than the comparative New Zealand buildings. This is attributed to the fact that all of the South African buildings are required to have an automatic fire sprinkler system installed. While New Zealand buildings of this height also require automatic fire sprinklers, the gain in attribute score is always offset against the permitted trade-offs (primarily increased maximum permissible travel distances).

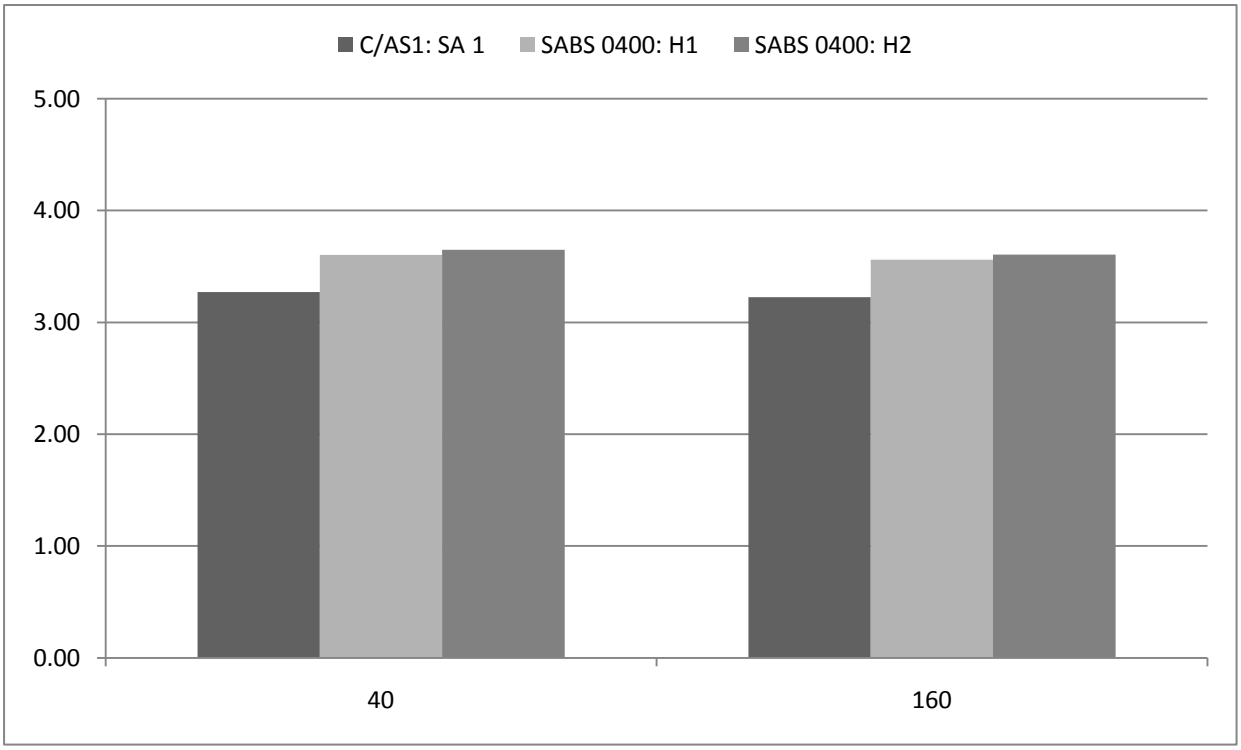

Figure 23 – SA 1: 34m to < 46m

SA 1: High Rise Buildings (> 33m), Occupant load less than 160 People

The fire safety features score for this range of buildings under both the South African Deemed to Satisfy rules and New Zealand Acceptable Solutions remains substantially the same as for the previous occupant load, with the South African buildings still appearing to be safer than the New Zealand buildings The decreases attributed to the lower building use score as the occupant increases are the only perceptible differences accounting for the slightly lower total fire safety index scores.

9.6. Fire Safety Index Results – Sleeping Residential (SR)

This group of buildings will only assess buildings with an occupant load of less than 40 people per firecell. The Fire Safety Index these buildings are calculated using spreadsheets which are attached as Appendices. These are attached as Appendix BR – Fire Safety Index Calculations – PG: SR (0m, ≤ 40 occupants) on page 293 and Appendix BS – Fire Safety Index Calculations – PG: SR (≤ 4m, ≤ 40 occupants) on page 296. Fire Safety Index scores for the other building heights have been calculated on separate spreadsheets which are not included in the appendices. The results of the fire safety index calculations for the SR (Sleeping Residential) purpose group are shown in Table 15.

Height	Building Classification	Occupant Number < 40
0 m	**C/AS1: SR 1**	1.47
	SANS 10400: H5	1.81
	SANS 10400: H3	1.84
< 4 m	**C/AS1: SR 1**	2.04
	SANS 10400: H5	2.04
	SANS 10400: H3	2.09
4 m to 10 m	**C/AS1: SR 1**	2.27
	SANS 10400: H5	2.34
	SANS 10400: H3	2.40
10 m to 25 m	**C/AS1: SR 1**	2.58
	SANS 10400: H5	2.33
	SANS 10400: H3	2.35
25 m to 34 m	**C/AS1: SR 1**	2.61
	SANS 10400: H5	2.26
	SANS 10400: H3	2.29
34 m to 46 m	**C/AS1: SR 1**	2.79
	SANS 10400: H5	-
	SANS 10400: H3	3.18

Table 15 – Fire Safety Index: Sleeping Residential Purpose Groups

9.7. Fire Safety Index Comparisons (SR 1)

9.7.1. SR 1: Single Storey (0m)

The comparative fire safety index scores for a single level building in the SR purpose group is shown in Figure 24 – SR 1: Single Storey (0m).

SR 1: Single Storey, Occupant load less than 40 People

For a Single Storey Residential type building (Escape Height 0m) South African buildings have a slightly higher fire safety index score than the New Zealand equivalent. This higher fire safety index score for South African buildings is attributed primarily to the Firecell rating requirement (+ 0.3008), the requirement for two escape routes (+ 0.0392) and a minimum width of 1200mm (+ 0.0196). These buildings only require a Structural fire endurance of 30 minutes (+ 0.0962).

New Zealand buildings have no Firecell rating (0), only require a single escape route (0) and have an escape route width of < 1000mm (0), but the requirement for a 60 minute Structural fire endurance of 60 minutes reduces the difference in the buildings (+ 0.1924). There are no other noticeable differences and this report will not comment on this any further.

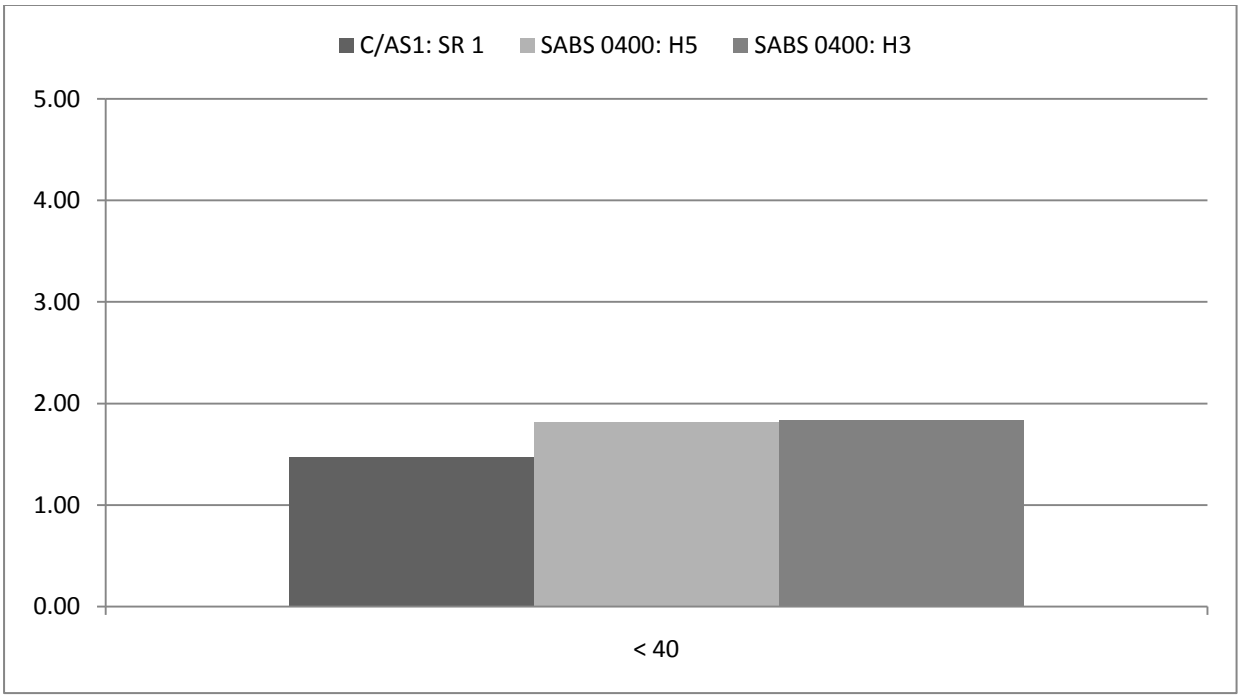

Figure 24 – SR 1: Single Storey (0m)

9.7.2. SR 1: Double Storey (Escape Height <4m)

The comparative fire safety index scores for double storey Sleeping Residential (SR) buildings are shown in Figure 25 – SR 1: Double Storey (< 4m).

SR 1: Double Storey, Occupant load less than 40 People

For this category of residential buildings the New Zealand buildings are deemed to be equally safe as the South African buildings. This increase in fire safety index score for Double Storey New Zealand buildings compared to Single Storey buildings is substantially due to the 45 minute Firecell rating requirement (+ 0.4512), and a net increase in the Structural fire endurance rating (+ 0.1924).

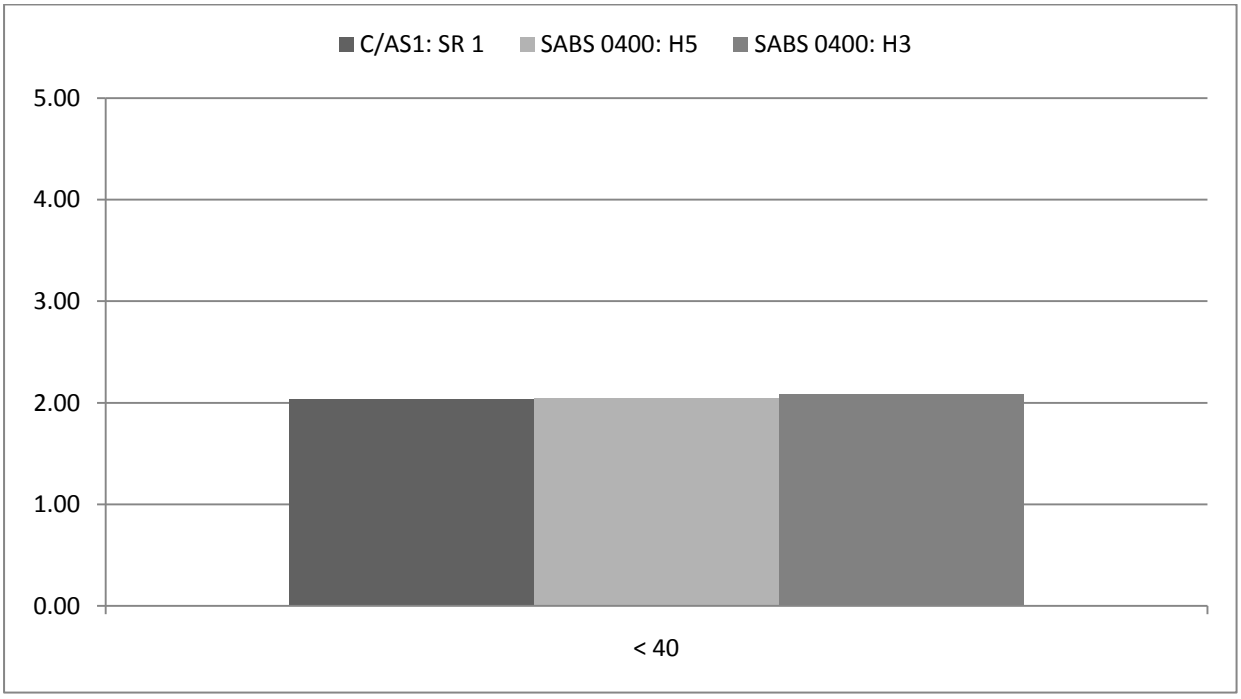

Figure 25 – SR 1: Double Storey (< 4m)

9.7.3. SR 1: Medium Height Buildings (10m to < 25m)

The comparative fire safety index scores for medium height Sleeping Residential buildings are shown in Figure 26 – SR 1: Medium Height Buildings (10m to < 25m).

SR 1: Medium Height (10m to <25m), Occupant load less than 40 People

For SA 1 Residential purpose buildings with an escape height in the range from 10m to < 25m (3 storeys to 10 storeys) and an occupant load of less than 40 people the New Zealand buildings have a higher fire safety index score (2.58) than South African buildings (H5 – 2.33 and H3 – 2.35). The higher fire safety index score for New Zealand buildings over South African buildings is mainly attributed to the Type 3 fire alarm system being a requirement for the New Zealand buildings with an increase for the alarm type (+ 0.47) which is offset against the increased travel distances permitted. The other differences are not considered significant enough to warrant further analysis.

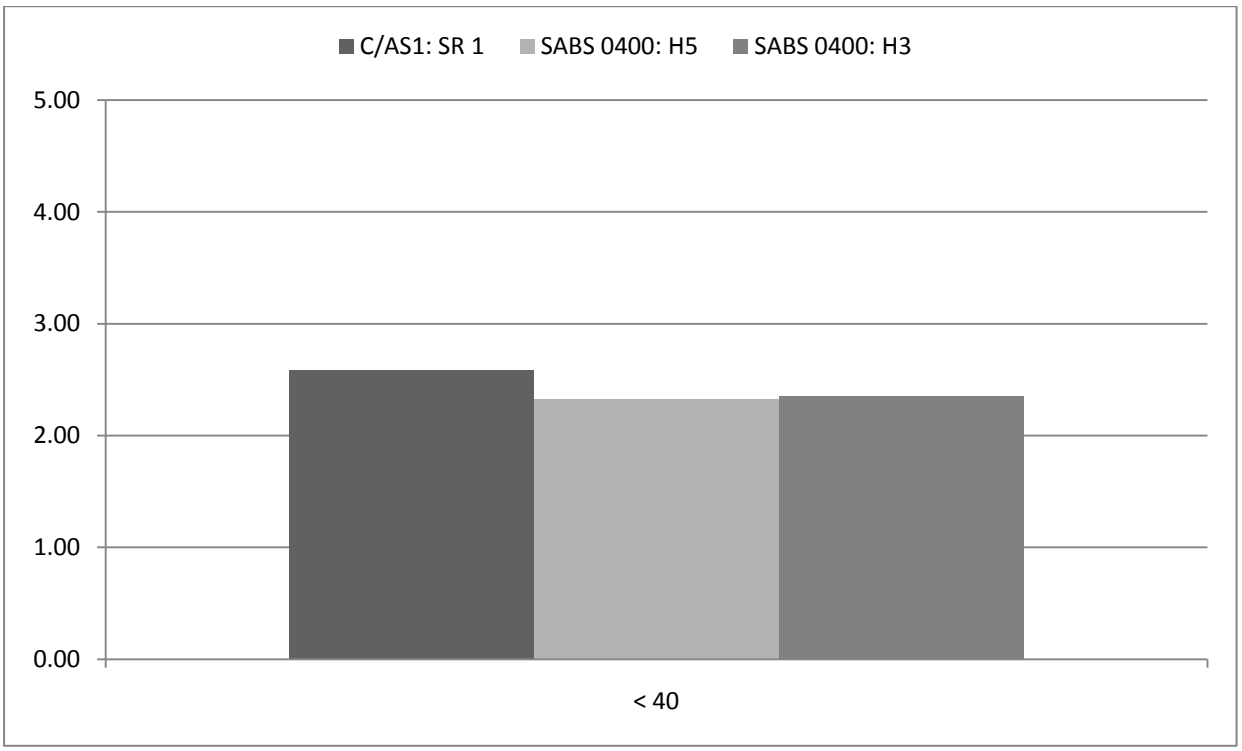

Figure 26 – SR 1: Medium Height Buildings (10m to < 25m)

9.7.4. SR 1: High Rise Buildings (> 33m)

Figure 27 – SR 1: 34m to < 46m, shows the comparative fire safety index scoring for high rise buildings in the Sleeping Residential (SR) occupancy class.

SR 1: High Rise Buildings (> 33m), Occupant load less than 40 People

For High rise buildings with an escape height of more than 33 metres and an occupant load of less than 40 people the South African H5 (Hospitality) occupancy class is no longer analysed due to the definition of the class precluding it from inclusion in this height grouping.

For this category, the South African H3 (Domestic Residence) has a higher fire safety index score than the comparative New Zealand buildings. This is attributed to the fact that an automatic fire alarm system with smoke detection (+ 0.588) is required to be installed. While New Zealand buildings of this height require automatic fire sprinklers and smoke detection, the gains in attribute score are always offset against the permitted trade-offs (primarily increased maximum permissible travel distances).

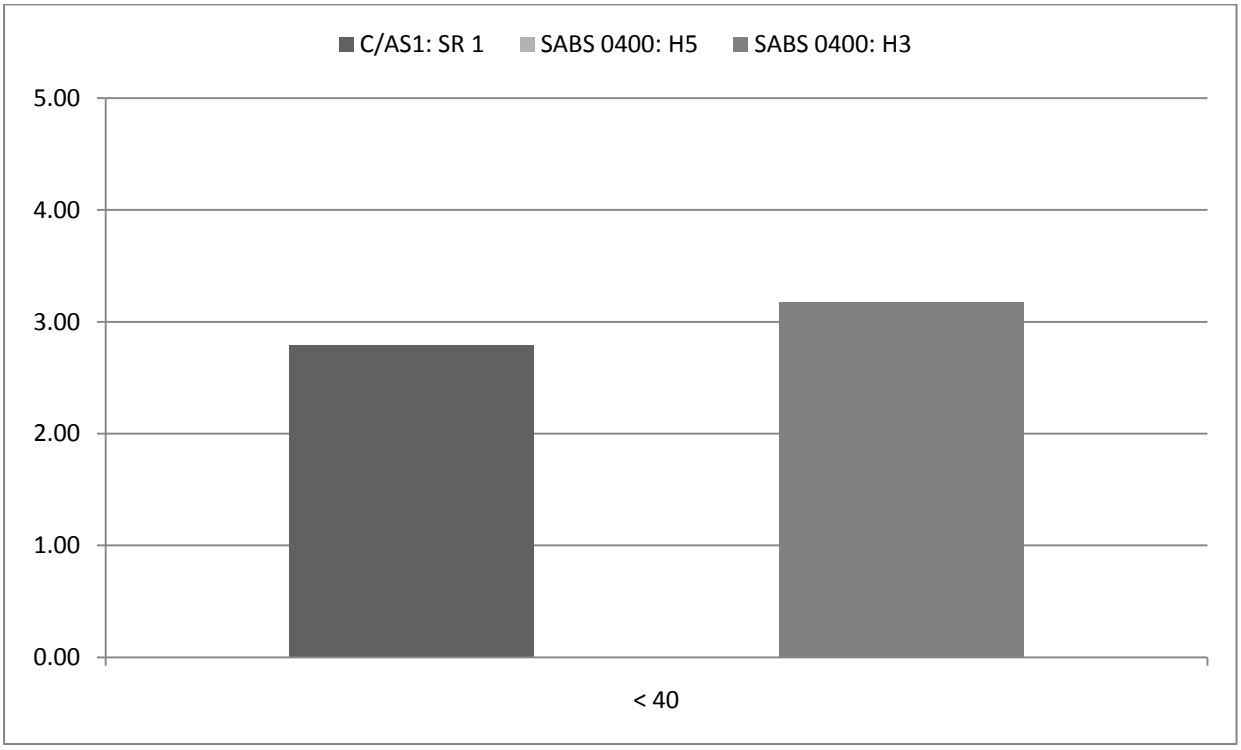

Figure 27 – SR 1: 34m to < 46m

9.8. Sleeping Accommodation Occupancies (SA 1)

For Single Storey Sleeping Accommodation type buildings the South African buildings have a higher fire safety index score than New Zealand Buildings when the occupant load is less than 40 people. When the occupant load is less than 160 people the New Zealand building is safer than the South African building.

In the Double Storey height range of buildings, the New Zealand buildings are safer than the South African buildings, for both occupant load categories.

In the height range 10 to < 25m, the two countries buildings achieve similar fire safety index scores and can be said to be equally safe.

Once the building height is above 34m, all South African buildings achieve higher fire safety index scores than New Zealand buildings.

9.9. Sleeping Residential Occupancies (SR 1)

For Single Storey Residential buildings the South African buildings have a higher fire safety index score than New Zealand Buildings.

The Double Storey Residential buildings are equally safe in both New Zealand and South Africa.

For the height range of 10 to 25m the New Zealand building is marginally safer than the equivalent South African building.

Once the building height is above 34m, the South African H3 (Domestic Residence) achieves a higher fire safety index score than New Zealand buildings.

10. SUMMARY SCORECARD

10.1. Summary Scorecard Methodology

From the previous sections an individual score is obtained for each separate building classification, occupancy number and building height. These give the relevant level of safety for separate buildings in each country. The object of this exercise is to determine an overall picture of the apparent level of safety for South African buildings compared to New Zealand buildings. The individual scores then need to be brought together to form an overall scoring to answer the question which was posed as the basis for this project.

Having already determined the relevant building scores from each occupancy section and building height, the next step is to calculate the fire safety index score based on the proportions of building stock by height. A discussion of the proportional representation of building stock is given in Section 3.3 Building Height.
The fire safety index scores obtained for each building height is then multiplied by the percentage (ratio) of the building height as represented in the total building stock in New Zealand. This then takes into account the weighting of the building height type in the total building stock. Using this approach also allows an equivalency to be assessed in countries with a different quantity of building stock at different heights. In essence this means that South African fire safety index scores are not skewed by virtue of South African buildings above 33m which receive higher fire safety index scores when sprinklers are installed, given that the building stock is predominantly one and two storey. Therefore by multiplying the fire safety index scores by the ratio of the building stock height these factors are taken into account.

As the South African buildings have several sub-categories of buildings within each purpose group being assessed it is necessary to make some sort of choice regarding how to assess the equivalent South African building against the New Zealand buildings in the purpose group. Consideration was given to assessing the comparisons over the highest and lowest South African scores or averaging the various scores out. It was deemed that this would add an unnecessary level of complication to the assessment. It was then decided that the building classification with the lowest score for a single level building with less than 50 occupants will be chosen for further comparison against the New Zealand building. Where the results (fire safety index score) for the any of the South African building occupancies are equal at this

building height, the occupancy class with the lowest score at the two storey building height will be used.

The scores for one and two storey buildings are directly multiplied by the weighting attributed to building height as discussed above.

For buildings over two storeys in height the fire safety index scores are then averaged out across the height ranges assessed to give a single score for buildings over two storeys high. Once the average has been calculated, the averaged fire safety index score is again multiplied by the ratio of building stock for buildings above two storeys high. Finally, the effect of the different occupancy loadings at each of the final three height categories are then again averaged out to give a single result representative of the various occupant loads.

The three weighted and averaged scores (for single storey, two storey and over two storey buildings and for the averaged occupant loads) is then summed to give a total weighted average scorecard for all buildings in that purpose group or occupancy classification.
This final score will be used to determine which country apparently has the safer buildings when designed and constructed in accordance with the prescriptive requirements of the deemed-to-satisfy documents, when scored according to McGhie's weighted fire safety index method.

10.2. Working Type Occupancies Summary Scorecard

Using the methodology discussed above a weighted, averaged score is determined for the Working type occupancies. The scores for single level South African buildings are assessed to determine which has the lowest fire safety index score. Referring back to Table 6 – Fire Safety Index: Working Purpose Groups, it is determined that the B3 (Low Risk Commercial Service) has the lowest score amongst the South African buildings. Thus for the remainder of this section only the B3 (Low Risk Commercial Service) building classification will be assessed against the New Zealand WL2 buildings.

As an example, taking the New Zealand WL 2 from Table 6, the fire safety index for a single level building with less than 50 occupants is 1.60. Using the percentage of building stock at this height gives 1.60 x 63% = 1.01. This is the weighted score. The other occupant number

groupings are similarly treated. The weighted occupant number scores are then averaged out to produce a weighted, averaged score for each of the three building heights. This final weighted, averaged total is what determines which country has apparently safer buildings, bearing in mind that the assessment is carried out for buildings designed and constructed in accordance with the relevant acceptable solution or deemed-to-satisfy rules.

This scorecard is shown in Table 16 with the graphical representation of the results shown in Figure 28 and Figure 29.

According to these results the South African Working Type occupancy buildings outscore the New Zealand buildings by 2.63 to 2.30, which is a difference of 6.6% when assessed over a possible total score of 5.

	Occupant Number / **Storeys**	**< 50**	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**	**Average by height**	**Total**
C/AS1: WL 2	1 storey	1.01	1.16	1.09	1.70	1.60	**1.31**	
	2 storey	0.68	0.74	0.67	0.79	0.79	**0.74**	
	> 2 storey (av.)	0.26	0.26	0.24	0.27	0.28	**0.26**	**2.30**
SANS 10400: B3	1 storey	1.19	1.17	1.93	1.88	1.86	**1.61**	
	2 storey	0.58	0.58	0.86	0.83	0.83	**0.74**	
	> 2 storey (av.)	0.25	0.25	0.32	0.31	0.31	**0.29**	**2.63**

Table 16 – Working Type Occupancies Summary Scorecard

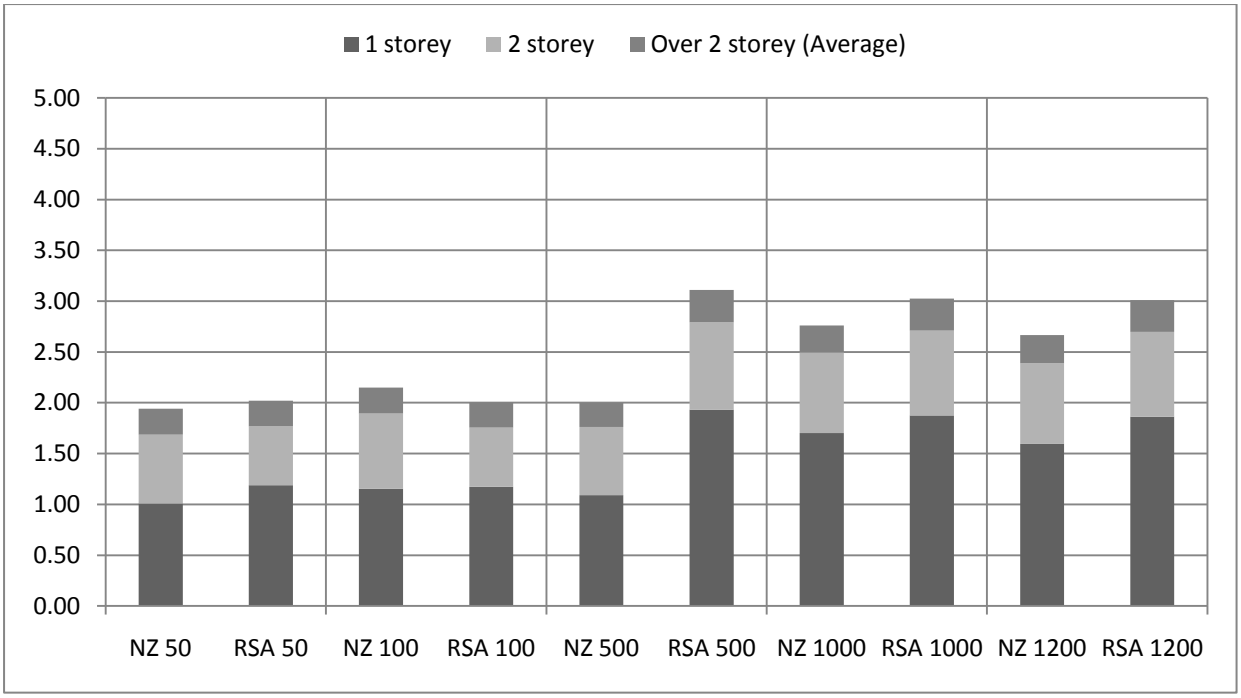

Figure 28 – Working Type Occupancies: Comparative Weighted Scores

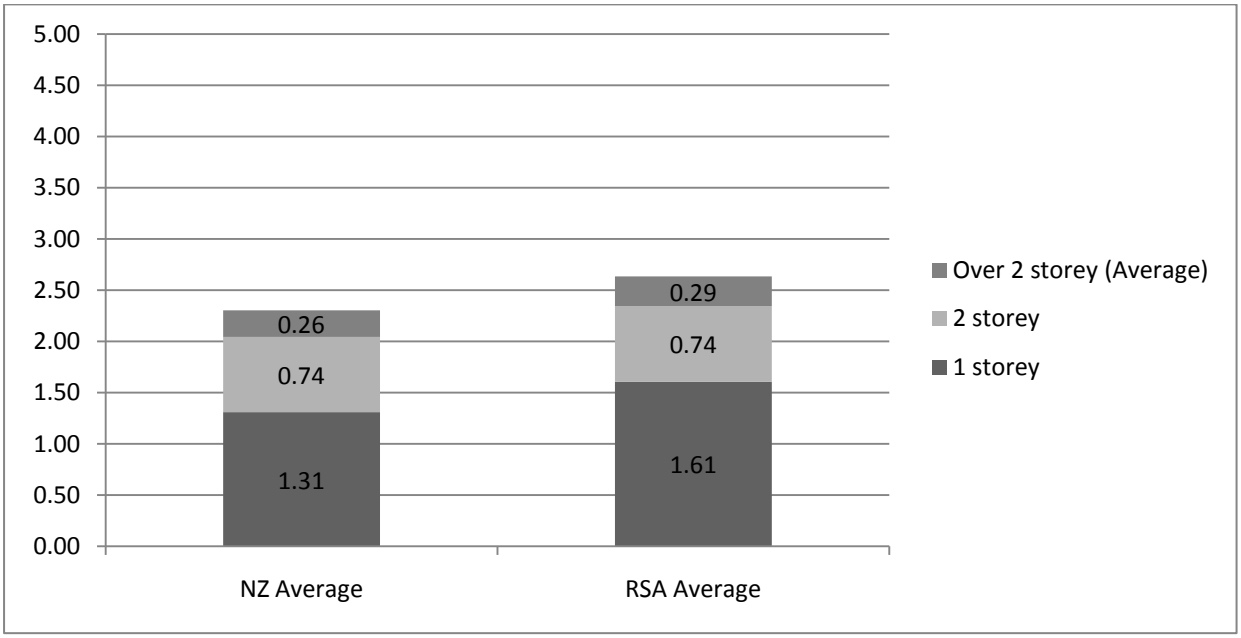

Figure 29 – Working Type Occupancies: Averaged Scorecard

10.3. Working Moderate Type Occupancies Summary Scorecard

Using the summary scorecard methodology discussed above a weighted, averaged score is determined for the Working Moderate fire load type occupancies. The scores recorded in Table 8 for single level South African buildings are assessed to determine which has the lowest fire safety index score. For the Moderate fire load working type occupancies, the B2 (Moderate Risk Commercial Service) and D2 (Moderate Risk Industrial) have equally the lowest score. The J2 (Moderate Risk Storage) achieves higher scores and will not be used further. For the remainder of this section only the B2 (Moderate Risk Commercial Service) building classification will be assessed against the New Zealand WM3 buildings. Using the same process as discussed for the Working type occupancies a weighted, averaged scorecard is produced. This is shown in Table 17. The results are then shown graphically in Figure 30 and Figure 31.

According to these results the South African buildings outscore the New Zealand buildings by 2.88 to 2.83, which is a difference of 1.0% when assessed over a possible total score of 5.

	Occupant Number / **Storeys**	**< 50**	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**	**Average by height**	**Total**
C/AS1: WM 3	1 storey	1.45	1.46	1.71	2.08	2.08	**1.76**	
	2 storey	0.69	0.69	0.80	0.97	0.97	**0.83**	
	> 2 storey (av.)	0.25	0.25	0.25	0.27	0.26	**0.25**	**2.83**
SANS 10400: B2	1 storey	1.52	1.51	1.76	2.15	2.15	**1.82**	
	2 storey	0.66	0.65	0.77	0.94	0.94	**0.79**	
	> 2 storey (av.)	0.24	0.24	0.27	0.31	0.31	**0.27**	**2.88**

Table 17 – Working Moderate Occupancies Summary Scorecard

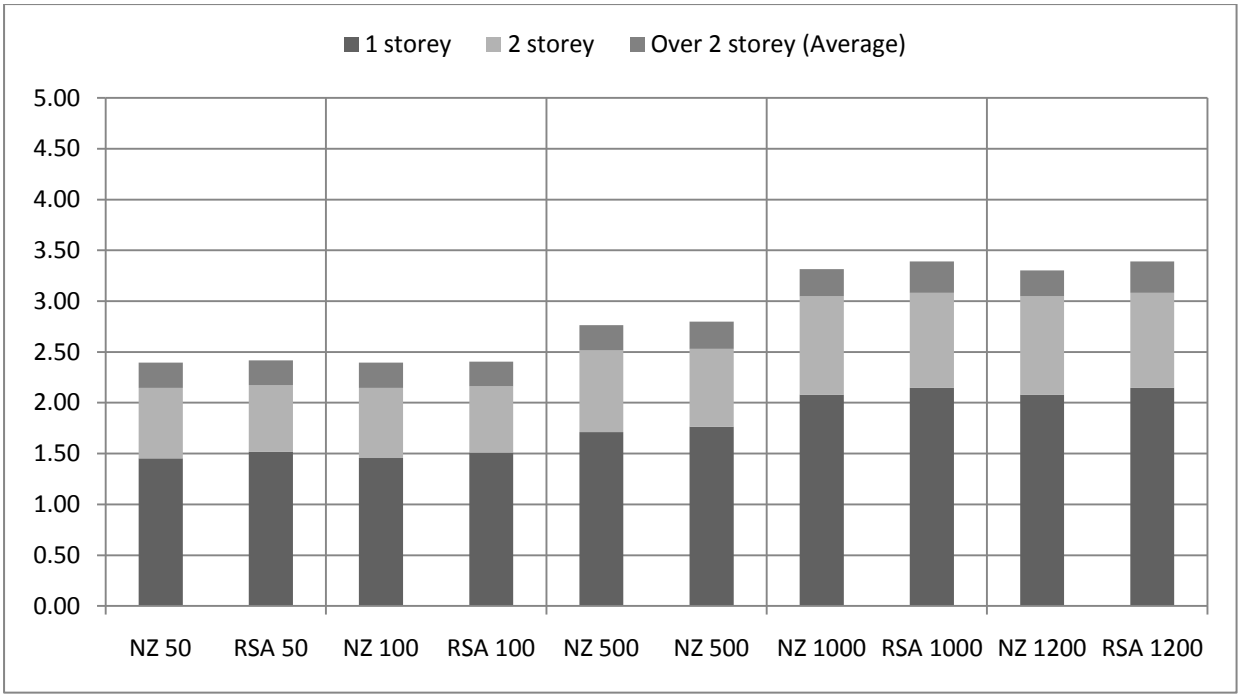

Figure 30 – Working Moderate Occupancies: Comparative Weighted Scores

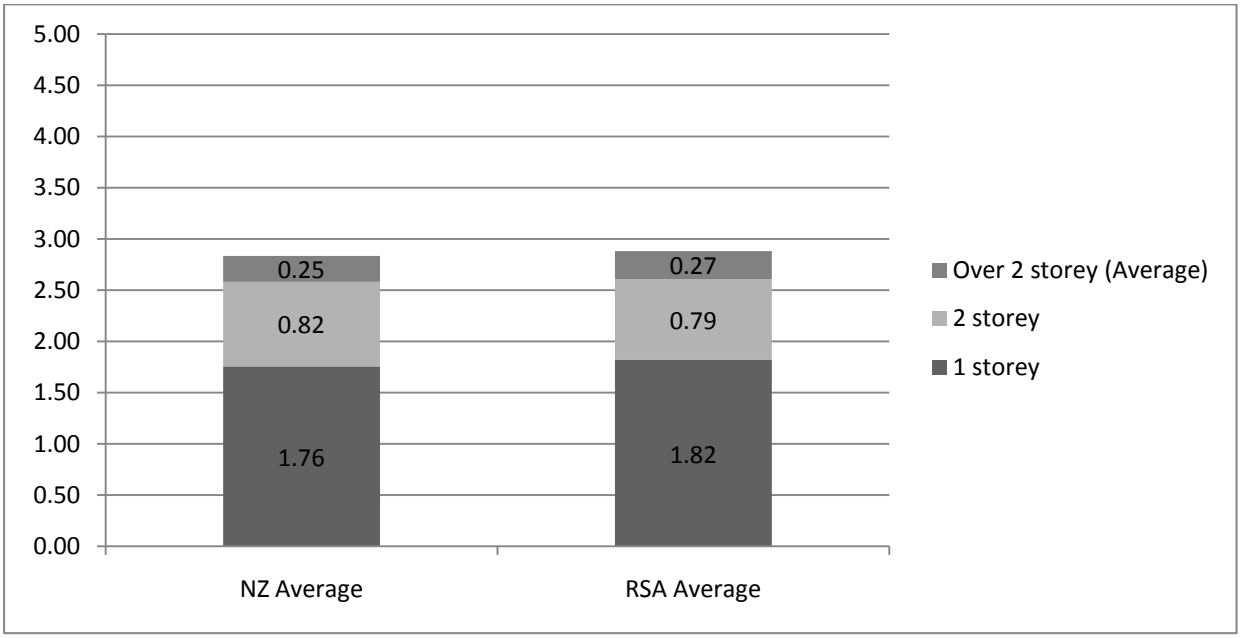

Figure 31 – Working Moderate Occupancies: Averaged Scorecard

10.4. Crowd Type Occupancies Summary Scorecard

The same summary scoring methodology is used for the Crowd type occupancies, and the scores for single level South African buildings from Table 10 are assessed to determine which South African occupancy has the lowest fire safety index score. For Crowd Type occupancies, the A4 (Worship) achieves the lowest score. The results for the A4 (Worship) buildings will be used for the remainder of this section for assessment against the New Zealand CS/CL type buildings. This scorecard is shown in Table 18 with the graphical representation of the results shown in Figure 32 and Figure 33.

According to these results the New Zealand buildings are safer than the South African buildings, with the scores being recorded as 2.34 to 2.05. This is a difference of 5.8% when assessed over a possible total score of 5.

	Occupant Number / **Storeys**	**< 50**	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**	**Average by height**	**Total**
C/AS1: CS / CL 2	1 storey	1.04	1.17	1.23	1.42	1.58	**1.29**	
	2 storey	0.69	0.75	0.77	0.85	0.79	**0.77**	
	> 2 storey (av.)	0.27	0.28	0.28	0.29	0.29	**0.28**	**2.34**
SANS 10400: A4	1 storey	1.10	1.20	1.22	1.20	1.19	**1.18**	
	2 storey	0.64	0.63	0.64	0.63	0.63	**0.63**	
	> 2 storey (av.)	0.24	0.24	0.24	0.24	0.24	**0.24**	**2.05**

Table 18 – Crowd Type Occupancies Summary Scorecard

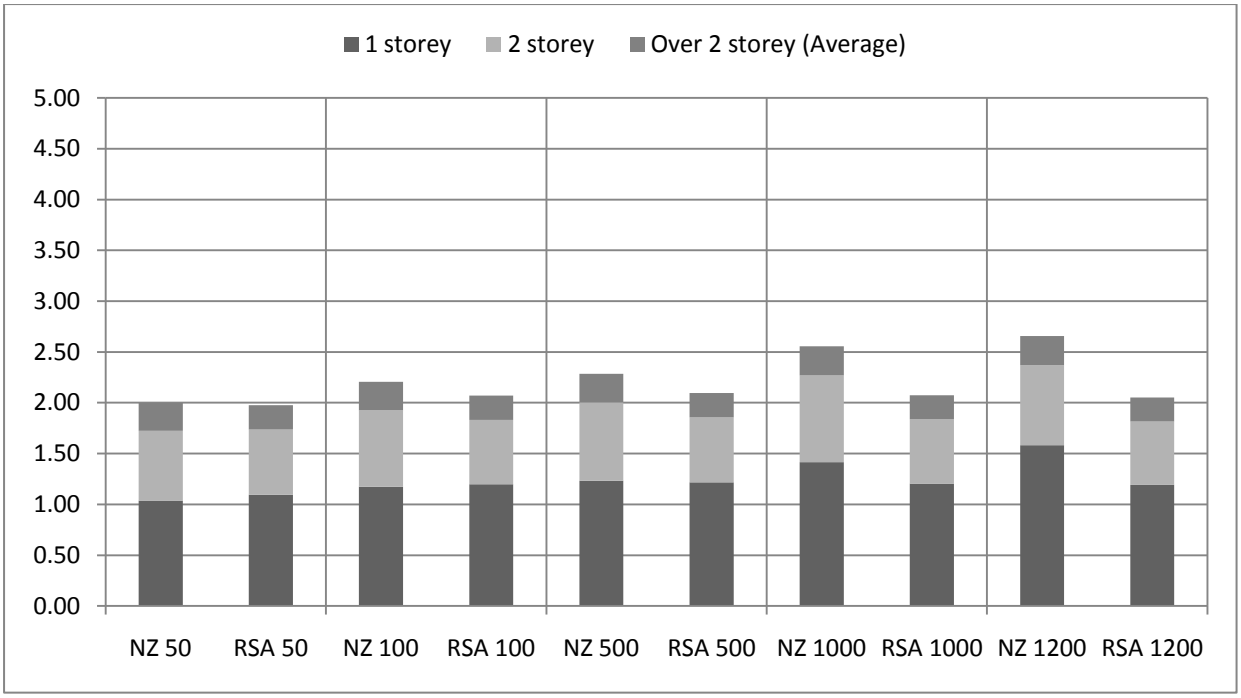

Figure 32 – Crowd Type Occupancies: Comparative Weighted Scores

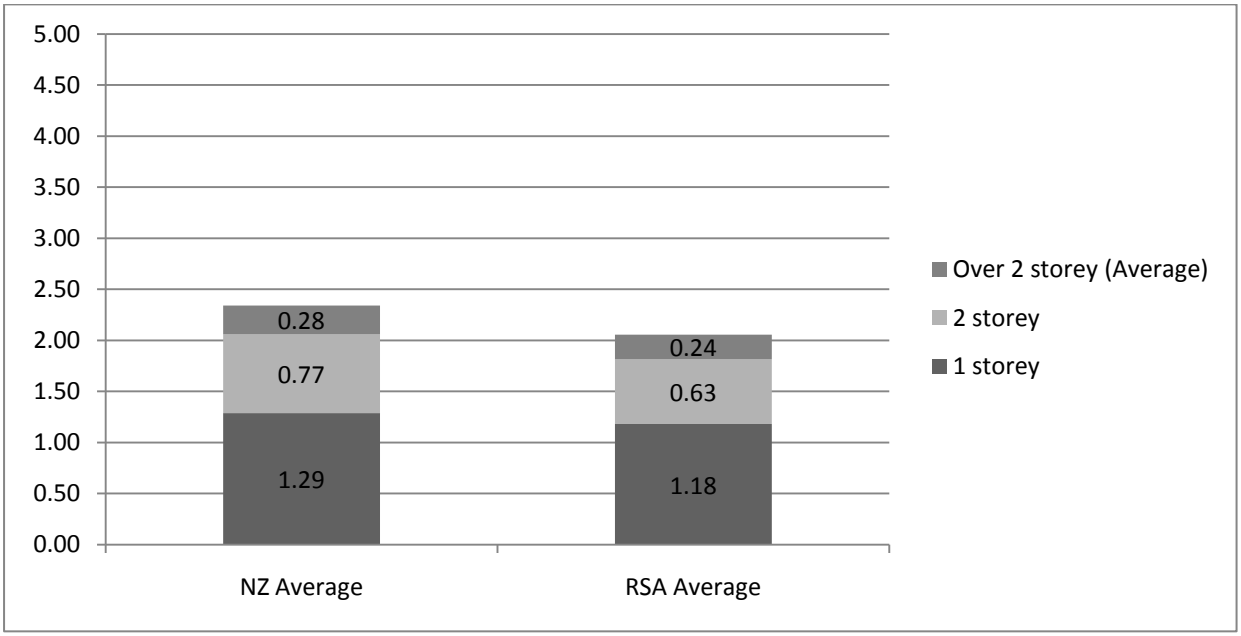

Figure 33 – Crowd Type Occupancies: Averaged Scorecard

10.5. Crowd Mercantile Type Occupancies Summary Scorecard

Using the methodology discussed above a weighted, averaged score is determined for the

Crowd Mercantile type occupancies. As before, the scores for single level South African buildings are assessed to determine which has the lowest fire safety index score. For the Crowd Mercantile type occupancies, the F1 (Large Shop) achieves the lowest score. The results for the F1 (Large Shop) buildings will be used for the remainder of this section for assessment against the New Zealand CM type buildings. This scorecard is shown in Table 19 with the graphical representation of the results shown in Figure 34 and Figure 35.

The South African buildings are safer than the New Zealand buildings. The South African building scores 3.14 against 2.32 for the New Zealand building. This is a difference of 16.4% when assessed over a possible total score of 5.

	Occupant Number / **Storeys**	**< 50**	**100**	**101 - 500**	**501 - 1000**	**> 1000 (1200)**	**Average by height**	**Total**
C/AS1: CM 2	1 storey	1.04	1.18	1.30	1.47	1.60	**1.32**	
	2 storey	0.69	0.76	0.68	0.70	0.79	**0.72**	
	> 2 storey (av.)	0.28	0.28	0.26	0.28	0.28	**0.28**	**2.32**
SANS 10400: F1	1 storey	1.16	1.95	2.22	2.03	2.20	**1.91**	
	2 storey	0.65	0.91	1.03	0.99	1.03	**0.92**	
	> 2 storey (av.)	0.25	0.30	0.33	0.33	0.33	**0.31**	**3.14**

Table 19 – Mercantile Type Occupancies Summary Scorecard

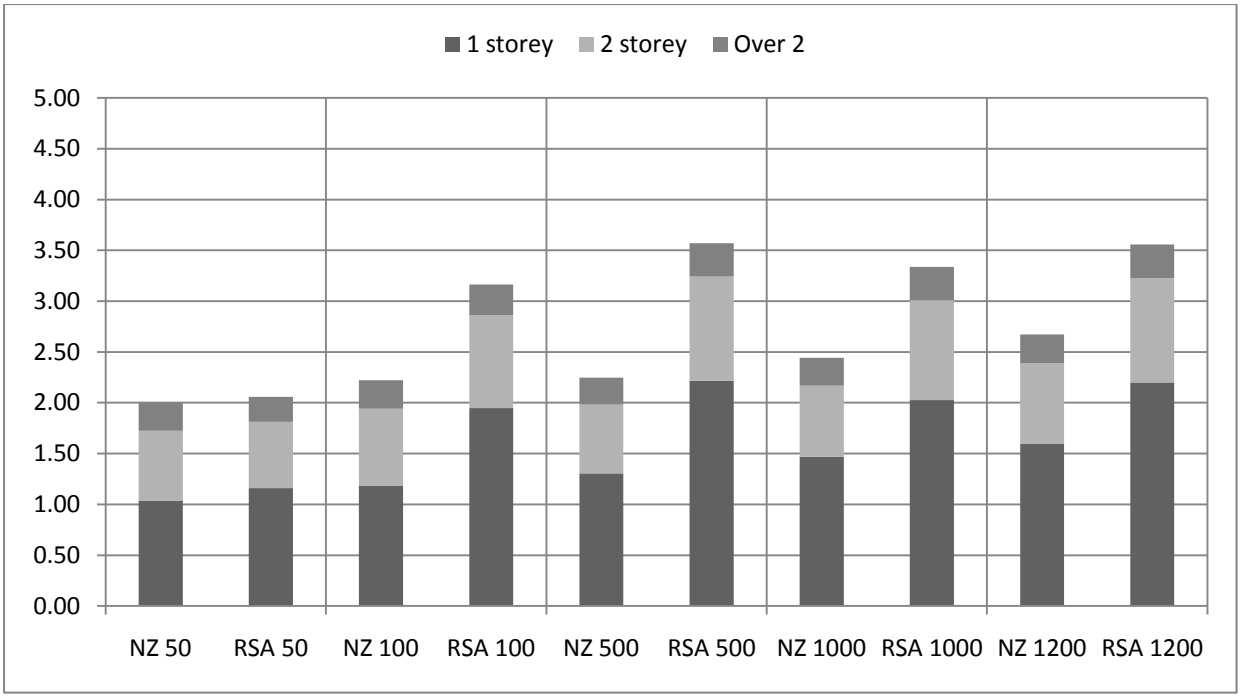

Figure 34 – Mercantile Type Occupancies: Comparative Weighted Scores

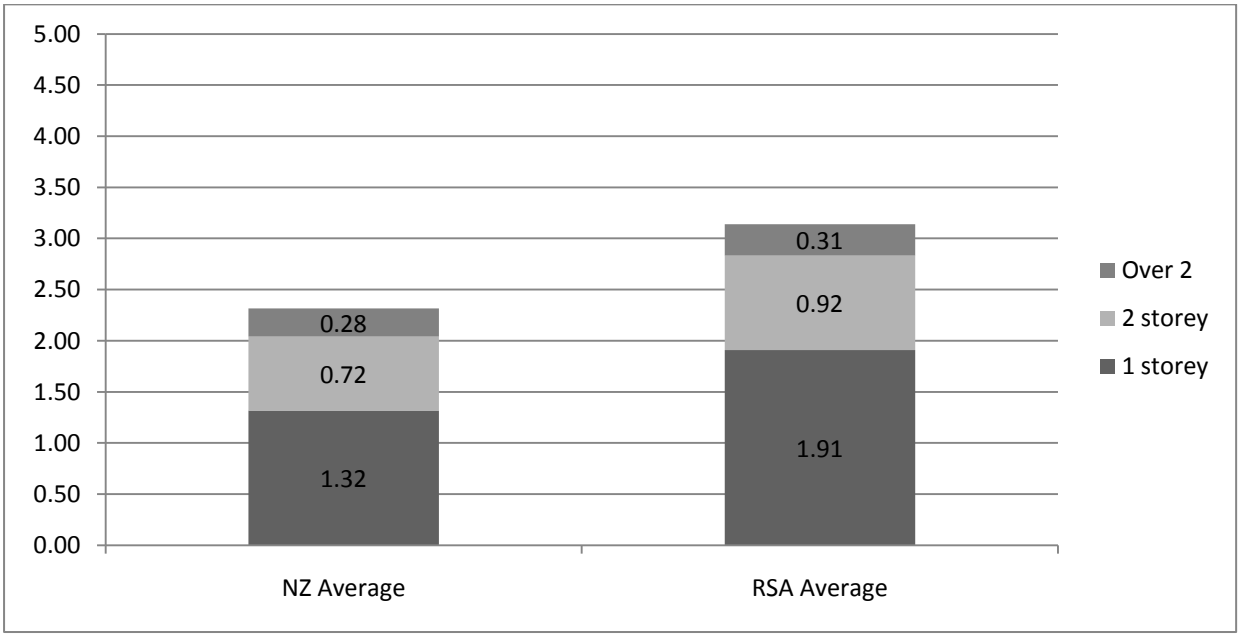

Figure 35 – Mercantile Type Occupancies: Averaged Scorecard

10.6. Sleeping Accommodation Occupancies Summary Scorecard

A weighted, averaged score is determined for the Sleeping Accommodation occupancies using the methodology discussed above. The scores for single level South African buildings from Table 14 are assessed to determine which has the lowest fire safety index score. The H1 (Hotel) and H2 (Dormitory) achieve equal scores at Ground level. The scores are then re-assessed at the two storey height. The H2 (Dormitory) achieves the lowest score. The results for the H2 (Dormitory) buildings will be used for the remainder of this section for assessment against the New Zealand SA type buildings. This is shown in Table 20. The results are shown graphically in Figure 36 and Figure 37.

The New Zealand buildings are safer than the South African building. The scores are 2.23 for the New Zealand building and 2.01 for the South African building. This is a difference of 4.4% when assessed over a possible total score of 5.

	Occupant Number / **Storeys**	**< 40**	**< 160**	**Average by height**	**Total**
C/AS1: SA 1	1 storey	1.05	1.40	**1.22**	
	2 storey	0.75	0.74	**0.75**	
	> 2 storey (av.)	0.27	0.26	**0.26**	**2.23**
SANS 10400: H2	1 storey	1.17	1.27	**1.22**	
	2 storey	0.58	0.58	**0.58**	
	> 2 storey (av.)	0.20	0.21	**0.21**	**2.01**

Table 20 – Sleeping Accommodation Occupancies Summary Scorecard

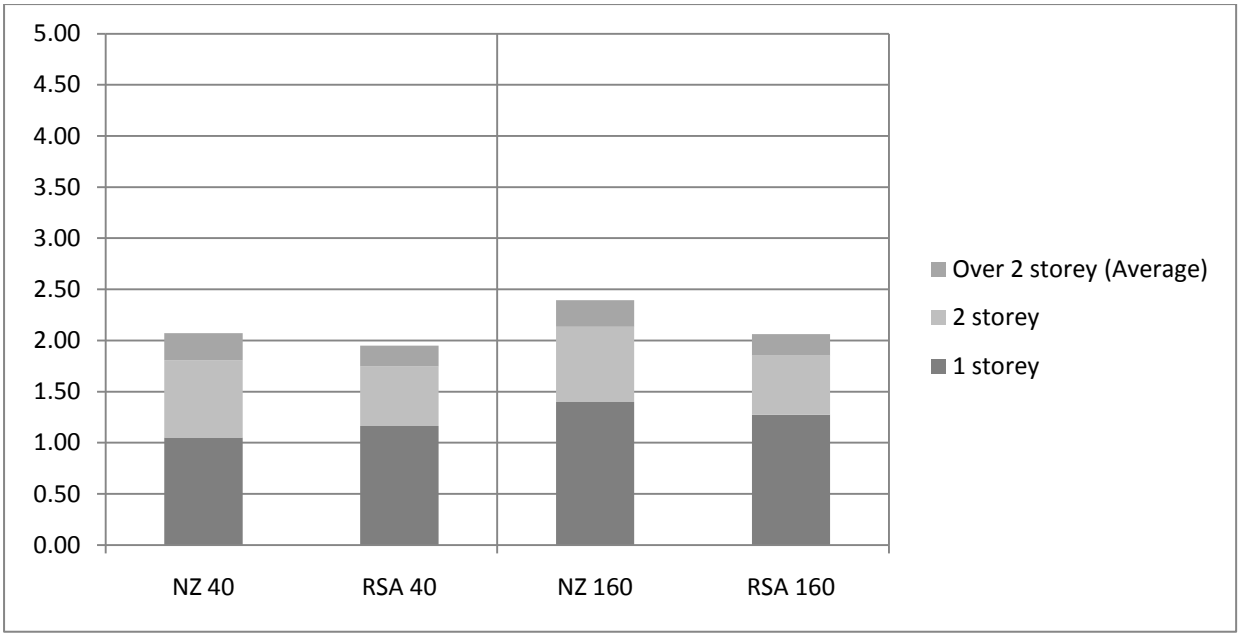

Figure 36 – Sleeping Accommodation: Comparative Weighted Scores

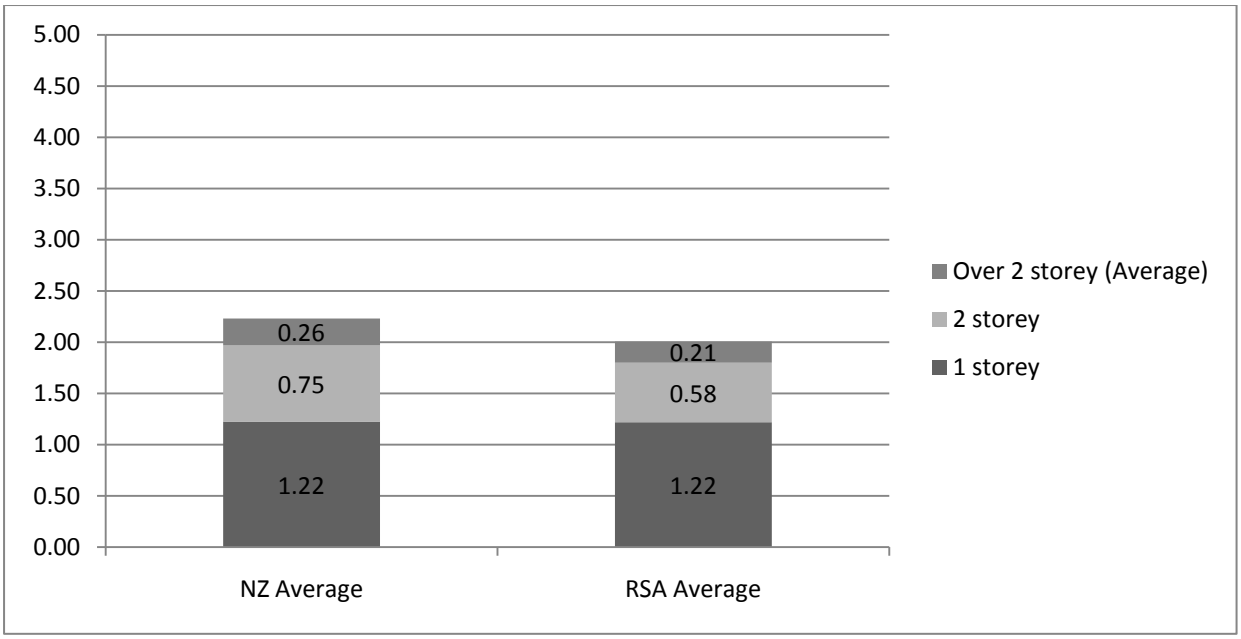

Figure 37 – Sleeping Accommodation: Averaged Scorecard

10.7. Sleeping Residential Occupancies Summary Scorecard

Using the summary scorecard methodology discussed above a weighted, averaged score is determined for the Sleeping Residential type occupancies. The scores from Table 15 for the two types of single level South African buildings are assessed to determine which has the lowest fire safety index score. For the Sleeping Residential occupancies, the H5 (Hospitality) achieves the lowest score. The results for the H5 (Hospitality) buildings will be used for the remainder of this section for assessment against the New Zealand Sleeping Residential type buildings. As only a single occupant load is assessed there is no requirement to average out the values at each building height. This is shown in Table 21. The results are then shown graphically in Figure 38.

The South African residential occupancies are safer than the New Zealand buildings. The South African building scores 1.94 against 1.73 for the New Zealand building. This is a difference of 4.2% when assessed over a possible total score of 5.

It is noticeable that these residential occupancy buildings achieve the lowest score of any building category in either country and yet fire deaths in domestic dwellings are higher than for other occupancy types.

	Occupant Number / **Storeys**	**< 40**	**Total**
C/AS1: SR 1	1 storey	0.92	
	2 storey	0.57	
	> 2 storey (av.)	0.23	**1.73**
SANS 10400:H5	1 storey	1.14	
	2 storey	0.57	
	> 2 storey (av.)	0.23	**1.94**

Table 21 – Sleeping Residential Occupancies Summary Scorecard

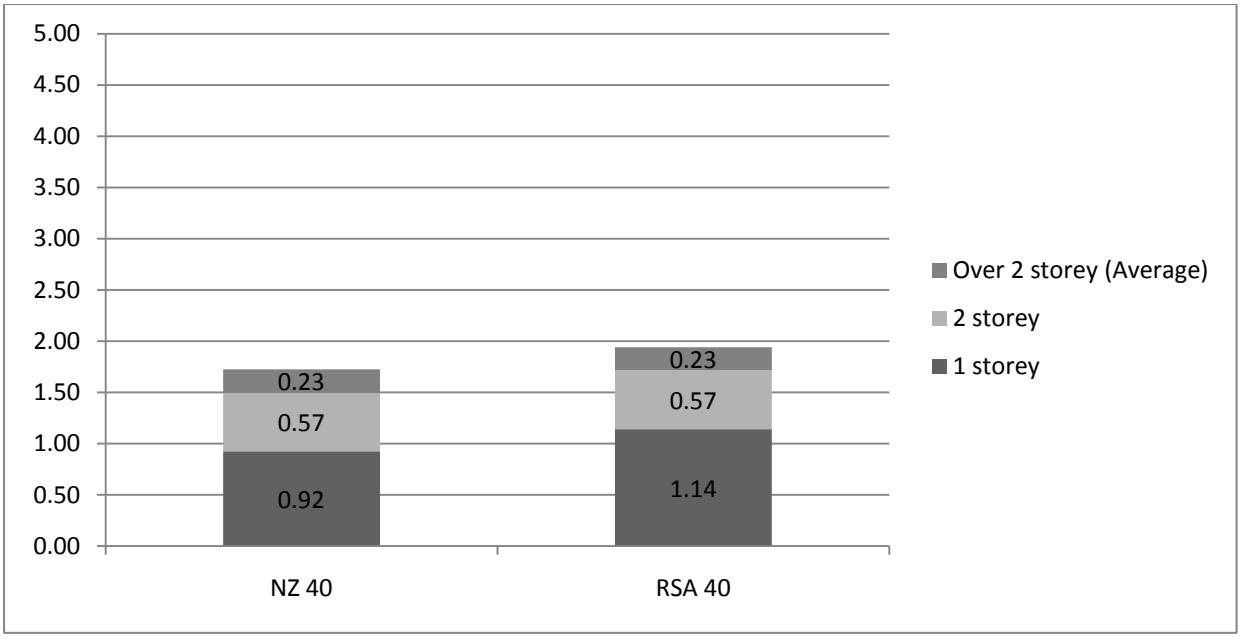

Figure 38 – Sleeping Residential: Comparative, Weighted, Averaged Scorecard

11. CONCLUSIONS

11.1. Discussion

Effects of Fire Alarm Systems on Scoring

For New Zealand buildings, there is no noticeable change in the scoring of the various building types assessed (Occupancy category, Occupant Numbers and Building Heights) when smoke detection or heat detection fire alarm systems are required. This is because of the permitted trade-offs when various fire detection systems are installed. The effect of the installation of a fire detection system is an increase in the scoring for the provision of the alarm system, but a commensurate decrease in scoring due to increased travel distances. These permitted trade-offs effectively mean that the level of safety in New Zealand buildings remain fairly consistent throughout the occupancy classification.

Effects of Sprinkler Systems on Scoring

When sprinkler systems are installed in South African buildings there is usually a step-change in the score. This is because the installation of a sprinkler system does not result in any permitted trade-offs in other areas, such as travel distances.

In New Zealand buildings, the level of safety, as recorded by the scoring system, does not change noticeably when sprinklers are installed. This is similar to the permitted trade-offs when fire detection systems are installed which primarily allow in increased travel distances. When sprinklers are required the level of safety remains fairly constant, which shows that the trade-offs permitted appear to be set at the right level.

11.2. Conclusions

The working (WL) type occupancies in South Africa are 6.6% safer are compared to similar buildings in New Zealand when the scores are weighted against the relevant building stock ratios.

For the working moderate fire load (WM) type occupancies the South African buildings are only 1.0% safer than comparative New Zealand buildings, which is close enough to be called equally safe.

For crowd occupancies, New Zealand buildings have a 5.8% higher weighted, averaged level of fire safety than the equivalent the South African buildings.

With crowd mercantile type occupancies the South Africa buildings offer a 16.4% higher level of safety when compared to similar buildings in New Zealand, and the scores are weighted against the relevant building stock ratios.

When the sleeping accommodation occupancies in South Africa are compared to similar buildings in New Zealand, and the scores are weighted against the relevant building stock ratios, the New Zealand accommodation buildings are 4.4% safer than South African buildings.

The sleeping residential occupancies in both countries achieve the lowest level of fire safety out of all of the buildings assessed. Out of a possible maximum score of 5, the buildings score 1.94 in New Zealand and 1.73 in South Africa. This is noted against the background of the high level of fire deaths in residential properties. The New Zealand sleeping residential buildings are 4.2% safer than comparable South African buildings

11.3. Combined Scorecard

A visual summarisation giving an overall picture of which country has the safer buildings is presented in Figure 39.
This shows that the South African Working Type Purpose Groups, (WL), Mercantile Occupancies (CM) and Sleeping Residential (SR) are all noticeably safer than the equivalent New Zealand buildings.

In the Crowd Occupancies (CL) and Sleeping Accommodation (SA) Purpose Groups the New Zealand C/AS1 compliant buildings are safer than the South African SANS 10400 compliant buildings.

The difference in scoring for the Working Moderate (WM) is insignificant, therefore the buildings are deemed to be equally safe in both New Zealand and South Africa.

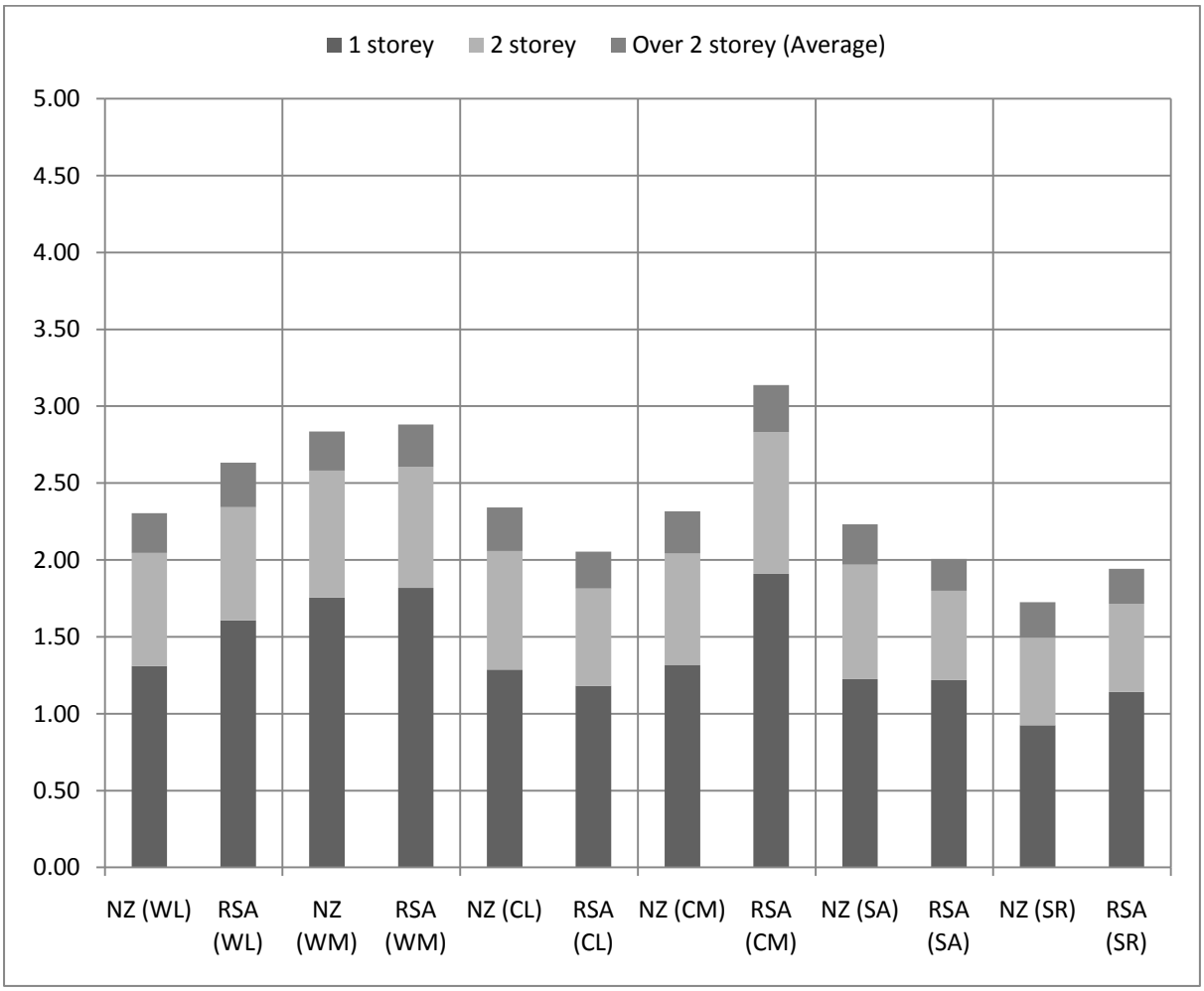

Figure 39 – Overall Combined Scorecard

11.4. Are South African buildings as safe as New Zealand buildings?

In answer to the question which formed the basis for this project it appears that when using the scoring system developed by McGhie, South African buildings are safer in three of the six categories assessed, while New Zealand buildings are safer than South African buildings in two categories and the buildings in one category are equally safe.

The differences are mainly within 10% of one another, with the exception of the Crowd Mercantile type occupancies which are 16.4% safer in the instance of South African buildings.

12. FURTHER RESEARCH

This report has identified certain areas which may warrant further research.

12.1. Sprinkler Water Supply

The New Zealand sprinkler standard NZS 4541:2007, Part 6 Water Supply – permits systems to be designed with a single water supply source. This is defined as a Class C1 water supply [21]. It is assumed that the intent of this may have been to make the installation of compliant sprinkler systems more affordable. This author has become aware of some instances of late, where the annual sprinkler system compliance checks has revealed that the single water supply source (usually town's mains) no longer meets the minimum design flow and pressure requirements for the sprinkler system. The reasons for this include degradation of the water mains, increased local demand as the area becomes built-up, and also water authorities reducing the available system pressure to reduce leakage. For whatever reason that the supply no longer meets the minimum flow and/or pressure requirements, the problem reverts to the building owner who is now faced with having to rectify the problem. Possible solutions include installing tanks and pumps or re-sizing the distribution pipe-work. These options all come with a large cost penalty. In some cases the building owner will attempt to have the premises re-evaluated and re-classified with a view to having the sprinkler system removed in order to avoid the costs of upgrading.

The issue of permitting a compliant sprinkler system to be initially designed and certified with only a single water supply source deserves serious reconsideration in order to avoid potential long term issues.

12.2. Fire Load Energy Density (FLED) for Residences

Table 2.1 of C/AS1 lists the Fire Hazard Category for all sleeping purpose groups as FHC1. This is for a fuel load energy density range of 0 MJ/m^2 to 500 MJ/m^2, and a design value of 400 MJ/m^2. This is in contrast to Office which have and FHC of 2 with a design FLED value of 800MJ/m^2. It is understood that these values are the same as those reported in the Fire Engineering Design Guide [25]which are from research work carried out in Switzerland in the late 1960's. This author is of the opinion that the fire loading in some modern houses is a least equivalent to, if not higher than, most modern offices, and that too many concessions are permitted for domestic residences. It is also noted that deaths due to fire in domestic

residences are approaching 50 per year in New Zealand, whereas deaths from fires occurring in offices is negligible. It is suggested that this be considered as an area for further research.

12.3. Surface Finishes

This report, in section 4.9.8 Surface Finishes Exitways and 4.9.9 Surface Finishes Occupied Spaces made certain assumptions with regard to the equivalencies of the requirements for surface finishes in South African buildings when assessed against the fire safety index attribute scores in McGhie's Fire Safety Index system. Due to the restrictions of this particular project, the author was unable to consider these equivalencies further. There is scope for further work in this area to better assess the equivalent spread of flame indices from the testing regime of one country as compared to that of another country. This becomes much more relevant as the trend toward globalisation continues and contractors increasingly source products from a variety of different manufacturers in different countries in order to achieve the best possible price.

12.4. Comparison with Other Jurisdictions

The Fire Safety Index system developed by McGhie has been demonstrated to be suitable for comparative assessment of the requirements of the South African deemed to satisfy Standard SANS 10400. There is further opportunity to use the system to evaluate the equivalent level of safety of buildings in other jurisdictions, such as buildings designed to be compliant with the Building Code of Australia.

12.5. Building Height Distributions for Other Occupancy Classes

The fire safety comparisons in this report have been based on the building stock of commercial buildings in New Zealand. This distribution has been applied for all building classes examined in this report. If another researcher were to obtain more accurate building stock distributions for other types of buildings, then the assessment could be carried out more specifically for those purpose groups or occupancy classes.

13. REFERENCES

1. South African Bureau of Standards., *SABS 0400 (SANS 10400:1990) The application of the National Building Regulations*, South African Bureau of Standards: Pretoria, South Africa.

2. Department of Building and Housing., *Compliance Document for New Zealand Building Code, Clause C1, C2, C3, C4. Fire Safety*. 2008, Vicbooks: Wellington.

3. McGhie, C., *Apparent Level of Safety of Buildings Meeting the New Zealand Building Code Approved Document C/AS1 - Fire Safety*. 2007, University of Canterbury: Christchurch. p. 239.

4. Boyes, J.W., *Risk Ranking of Buildings for Life Safety*. 1997, University of Canterbury: Christchurch. p. 85.

5. National Fire Protection Association., *NFPA 101A Guide on Alternative Approaches to Life Safety*. 2010: National Fire Protection Association.

6. Karlsson, B. and D. Larsson, *Using a Delphi panel for developing a fire risk index method for multistorey apartment buildings*. 2000, Lund, Sweden: Dept. of Fire Safety Engineering, Lund University. iii, 8, 132, 22, 8 p.

7. National Fire Protection Association., *NFPA 101: Life safety code : code for safety to life from fire in buildings and structures*. 2000 ed. 2000, Quincy, MA: National Fire Protection Association. 387 p.

8. Walker, G.G., *The Ballantyne fire disaster*. 1983, Christchurch. 102, 92 p., [8] p. of plates.

9. *National Building Regulations and Building Standards Act, No. 103*. 1977: Republic of South Africa.

10. *Standards Act, No. 30*. 1982: Republic of South Africa.

11. *National Building Regulations and Building Standards Amendment Act, No 36*. 1984: Republic of South Africa.

12. *National Building Regulations and Building Standards Amendment Act, No. 62*. 1989: Republic of South Africa.

13. *National Building Regulations and Building Standards Amendment Act, No. 49*. 1995: Republic of South Africa.

14. New Zealand Government, *Building Act 2004*. 2004: New Zealand.

15. Department of Trade and Industry, *Regulation R.574, National Building Regulations and Building Standards Act, 1977 (Act 103 of 1977)*, in *No. 31084*, Department of Trade and Industry, Editor. 2008, Government Printer: Pretoria, RSA. p. 23.

16. *Determination 2004/5*, in *Building Industry Authority*. 2004, Building Industry Authority: Wellington, NZ.

17. Department of Building and Housing. *The availability of earlier determinations and how they are used*. About Determinations 2010 [cited 2010 2010-04-20].

18. Page, I., *ME(Civil), Manager: Economics, BRANZ, Personal Communication*. 2010-03-31.

19. South African Bureau of Standards., *SABS 0139 (SANS 10139:2007) The prevention, automatic detection and extinguishing of fire in buildings*, South African Bureau of Standards: Pretoria, South Africa.

20. South African Bureau of Standards., *SANS 10287:2000 (SABS 0287) Automatic sprinkler installations for fire-fighting purposes*. 2000, South African Bureau of Standards: Pretoria, RSA.

21. Standards New Zealand., *NZS 4541:2007 Automatic fire sprinkler systems*. 2007, Standards New Zealand: Wellington, N.Z. p. 506.

22. Koffel, W.E., *Reliability of Automatic Sprinkler Systems*. 2005, Alliance for Fire Safety.

23. Marryatt, H.W., et al., *Fire : a century of automatic sprinkler protection in Australia and New Zealand 1886-1986*. Rev. ed. 1988, North Melbourne, Vic: Australian Fire Protection Association in co-operation with National Fire Protection Association International and National Fire Sprinklers Association Inc. U.S.A. 478 p.

24. New Zealand Government, *Fire Safety and Evacuation of Buildings Regulations 2006*, in *SR 2006/123*, Department of Internal Affairs, Editor. 2006: Wellington, NZ.

25. Spearpoint, M.J., ed. *Fire Engineering Design Guide*. 3rd ed. 2008, New Zealand Centre for Advanced Engineering: Christchurch, N.Z. 366 p.

14. APPENDICES

Appendix A – C/AS1 – Table 2.1: Purpose Groups

Table 2.1: Purpose Groups
Paragraphs 1.3.4, 2.1.3, 2.2.1, 2.2.10, 5.6.11 and 5.6.13

Purpose group	Description of intended use of the building space	Some examples	Fire hazard category
CROWD ACTIVITIES			
CS or CL	For *occupied spaces*. CS applies to *occupant loads* up to 100 and CL to *occupant loads* exceeding 100.	Cinemas when classed as CS, art galleries, auditoria, bowling alleys, churches, clubs (non-residential), community halls, court rooms, dance halls, day care centres, gymnasia, lecture halls, museums, eating places (excluding kitchens), taverns, enclosed grandstands, indoor swimming pools.	1
		Cinemas when classed as CL, schools, colleges and tertiary institutions, libraries (up to 2.4 m high book storage), nightclubs, restaurants and eating places with cooking facilities, *early childhood centres theatre* stages, opera houses, television studios (with audience).	2
		Libraries (over 2.4 m high book storage).	3
CO	Spaces for viewing open air activities (does not include spaces below a grandstand).	Open grandstands, roofed but unenclosed grandstand, uncovered fixed seating.	1
CM	Spaces for displaying, or selling retail goods, wares or merchandise.	Exhibition halls, retail shops.	2
		Supermarkets or other stores with bulk storage/display over 3.0 m high.	4
SLEEPING ACTIVITIES			
SC	Spaces in which *principal users* because of age, mental or physical limitations require special care or treatment.	Hospitals. Care institutions for the aged, children, *people with disabilities*.	1
SD	Spaces in which *principal users* are restrained or liberties are restricted.	Care institutions, for the aged or children, with physical restraint or detention.	1
		Hospital with physical restraint, detention quarters in a police station, prison.	
SA	Spaces provided for the use of people who will be transient and reside for a temporary period, typically not more than 90 days, or where limited assistance or care is provided for *principal users*.	Motels, hotels, hostels, boarding houses, clubs (residential), boarding schools, dormitories, halls of residence, *wharenui*, community care institutions.	1
SR	Attached and multi-unit residential dwellings.	*Multi-unit dwellings* or flats, apartments, and includes *household units* attached to the same or other *purpose groups*, such as caretakers' flats, and residential accommodation above a shop.	1
		Household unit firecells may contain garages which are used exclusively by the occupants of that *household unit*.	
		Excludes sleeping accommodation used for a temporary period typically no more than 90 days	
SH	Detached dwellings where people live as a single household or family.	Dwellings, houses, being *household units*, or *suites* in *purpose group* SA, separated from each other by distance. Detached dwellings may include attached self-contained *suites* such as granny flats when occupied by a member of the same family, and garages whether detached or part of the same *building* and are primarily for storage of the occupants' vehicles, tools and garden implements.	1

Table 2.1: Purpose Groups *(continued)*

Purpose group	Description of intended use of the building space	Some examples	Fire hazard category
WORKING, BUSINESS OR STORAGE ACTIVITIES			
WL	Spaces used for working, business or storage – low *fire load*.	Manufacturing, processing or storage of *non-combustible* materials, or materials having a slow heat release rate, cool stores, covered cattle yards, wineries, grading or storage or packing of horticultural products, wet meat processing.	1
		Banks, hairdressing shops, beauty parlours, personal or professional services, dental offices, laundry (self-service), medical offices, business or other offices, police stations (without detention quarters), radio stations, television studios (no audience), small tool and appliance rental and service, telephone exchanges, dry meat processing.	2
WM	Spaces used for working, business or storage – medium *fire load* and slow/medium/fast *fire* growth rates (e.g. <1 MW in 75 sec) **(Note 1)**.	Manufacturing and processing of *combustible* materials not otherwise listed, including bulk storage up to 3 m high (excluding *foamed plastics*).	3
WH	Spaces used for working, business or storage – high *fire load* and slow/medium/fast *fire* growth rates (e.g. <1 MW in 75 sec) **(Note 1)**.	Chemical manufacturing or processing plants, distilleries, feed mills, flour mills, lacquer factories, mattress factories, rubber processing plants, spray painting operations, plastics manufacturing, bulk storage of *combustible* materials over 3 m high (excluding *foamed plastics*).	4
WF	Spaces used for working, business or storage – medium/high *fire load* and ultra fast *fire* growth rates (e.g. >1 MW in 75 sec) **(Note 1)**.	Areas involving significant quantities of highly *combustible* and flammable or explosive materials which because of their inherent characteristics constitute a special *fire hazard*, including: bulk plants for flammable liquids or gases, bulk storage warehouses for flammable substances, bulk storage of *foamed plastics*.	4 (The critical factor in this *purpose group* is the rate of *fire* growth.)
INTERMITTENT ACTIVITIES			
IE	*Exitways* on *escape routes*.	*Protected path, safe path*.	1
IA	Spaces for intermittent occupation or providing intermittently used support functions – low *fire load*.	Car parking, garages, carports, enclosed corridors, unstaffed kitchens or laundries, lift shafts, locker rooms, linen rooms, open balconies, *stairways* (within the *open path*), toilets and amenities, and service rooms incorporating machinery or equipment not using solid-fuel, gas or petroleum products as an energy source **(Note 2)**.	1
ID	Spaces for intermittent occupation or providing intermittently used support functions – medium *fire load*.	Maintenance workshops and service rooms incorporating machinery or equipment using solid-fuel, gas or petroleum products as an energy source **(Note 2)**.	3

Notes:

1. Refer to NFPA 92B for more information on *fire* growth rates.
2. Service rooms are spaces designed to accommodate any of the following: boiler/plant equipment, furnaces, incinerators, refuse, caretaking/cleaning equipment, airconditioning, heating, plumbing or electrical equipment, pipes, lift/escalator machine rooms, or similar services.

Appendix B – SANS 10400 – Part A, Table 1: Occupancy or Building Classification

TABLE 1 — OCCUPANCY OR BUILDING CLASSIFICATION

1 Class of occupancy or building	2 Occupancy
A1 CS/CL2	**Entertainment and public assembly** Occupancy where persons gather to eat, drink, dance or participate in other recreation.
A2 CS/CL2	**Theatrical and indoor sport** Occupancy where persons gather for the viewing of theatrical, operatic, orchestral, choral, cinematographical or sport performances.
A3 CS/CL 1 OR 2	**Places of instruction** Occupancy where school children, students or other persons assemble for the purpose of tuition or learning.
A4 CS/CL 1	**Worship** Occupancy where persons assemble for the purpose of worshipping.
A5 CO 1	**Outdoor sport** Occupancy where persons view outdoor sports events.
B1 WH/WF 4	**High risk commercial service** Occupancy where a non-industrial process is carried out and where either the material handled or the process carried out is liable, in the event of fire, to cause combustion with extreme rapidity or give rise to poisonous fumes, or cause explosions.
B2 WM 3	**Moderate risk commercial service** Occupancy where a non-industrial process is carried out and where either the material handled or the process carried out is liable, in the event of fire, to cause combustion with moderate rapidity but is not likely to give rise to poisonous fumes, or cause explosions.
B3 WL 1 OR 2	**Low risk commercial service** Occupancy where a non-industrial process is carried out and where neither the material handled nor the process carried out falls into the high or moderate risk category.
C1 CM 2	**Exhibition hall** Occupancy where goods are displayed primarily for viewing by the public.
C2 CS/CL 1	**Museum** Occupancy comprising a museum, art gallery or library.
D1 WF, WH 4	**High risk industrial** Occupancy where an industrial process is carried out and where either the material handled or the process carried out is liable, in the event of fire, to cause combustion with extreme rapidity or give rise to poisonous fumes, or cause explosions.
D2 I, M 3	**Moderate risk industrial** Occupancy where an industrial process is carried out and where either the material handled or the process carried out is liable, in the event of fire, to cause combustion with moderate rapidity but is not likely to give rise to poisonous fumes, or cause explosions.
D3 WL 1 OR 2	**Low risk industrial** Occupancy where an industrial process is carried out and where neither the material handled nor the process carried out falls into the high or moderate risk category.
D4 IA/ID 1 OR 3	**Plant room** Occupancy comprising usually unattended mechanical or electrical services necessary for the running of a building.
E1 SD 1	**Place of detention** Occupancy where people are detained for punitive or corrective reasons or because of their mental condition.
E2 SC/SD 1	**Hospital** Occupancy where people are cared for or treated because of physical or mental disabilities and where they are generally bed-ridden.
E3 SC/SD 1	**Other institutional (residential)** Occupancy where groups of people who either are not fully fit, or who are restricted in their movements or their ability to make decisions, reside and are cared for.
F1 CM 2 OR 4	**Large shop** Occupancy where merchandise is displayed and offered for sale to the public and the floor area exceeds 250 m² .
F2 CM 2	**Small shop** Occupancy where merchandise is displayed and offered for sale to the public and the floor area does not exceed 250 m² .
F3 WL 2, 3 OR 4	**Wholesalers' store** Occupancy where goods are displayed and stored and where only a limited selected group of persons is present at any one time.
E4 SC 1	**Health care** Occupancy which is a common place of long term or transient living for a number of unrelated persons consisting of a single unit on its own site who, due to varying degrees of incapacity, are provided with personal care services or are undergoing medical treatment.

Table 1 (continu

	H5 SA 1	**Hospitality** Occupancy where unrelated persons rent furnished rooms on a transient basis within a dwelling house or domestic residence with sleeping accommodation for not more than 16 persons within a dwelling unit.

1

Class of occupancy or building	Occupancy
G1 WL 2	**Offices** Occupancy comprising offices, banks, consulting rooms and other similar usage.
H1 SA 1	**Hotel** Occupancy where persons rent furnished rooms, not being dwelling units.
H2 SA 1 (GROUP SHARING)	**Dormitory** Occupancy where groups of people are accommodated in one room.
H3 SR 1	**Domestic residence** Occupancy consisting of two or more dwelling units on a single site.
H4 SH 1	**Dwelling house** Occupancy consisting of a dwelling unit on its own site, including a garage and other domestic outbuildings, if any.
J1 WF/WH 4	**High risk storage** Occupancy where material is stored and where the stored material is liable, in the event of fire, to cause combustion with extreme rapidity or give rise to poisonous fumes, or cause explosions.
J2 WM 3	**Moderate risk storage** Occupancy where material is stored and where the stored material is liable, in the event of fire, to cause combustion with moderate rapidity but is not likely to give rise to poisonous fumes, or cause explosions.
J3 WL 1 OR 2	**Low risk storage** Occupancy where the material stored does not fall into the high or moderate risk category.
J4 IA 1	**Parking garage** Occupancy used for storing or parking of more than 10 motor vehicles.

Appendix C – C/AS1: Fire Hazard Categories

2.1 General

2.1.1 Designing a *building* to provide *adequate fire* safety, involves decisions on both the *construction* materials and layout needed to reduce the perceived risk to an acceptable level.

2.1.2 The risk is assessed according to:

a) The number and mobility of the occupants (*occupant load*).

b) The activities undertaken within the *building*.

c) The nature of the *building* materials and contents.

2.1.3 That assessment allows each *building* space to be categorised in a *purpose group* (see Table 2.1) which is the basis for determining *fire safety precautions*.

2.2 Purpose Groups and Fire Hazard Categories

2.2.1 Table 2.1 shall be used to determine the *purpose group* appropriate to the activity, and the *fire hazard category (FHC)*. When a specific activity is not shown in Table 2.1, the nearest suitable *purpose group* and *fire hazard category* must be chosen.

COMMENT:

1. The *purpose group* is used as an entry point to several parts of this acceptable solution, e.g. when determining the number and size of *exitways* and other *fire safety precautions*.

2. The *fire hazard category* is used to determine the *S rating* requirements of Part 4. While there is a relationship between the *fire hazard category* and the *Fire Load Energy Density (FLED)*, it is recognised that *FLED* is only one factor affecting the *fire* severity and thus the impact of the *fire* on the *building* structure. Other important factors may include ventilation, surface area to mass ratio of the fuel, and its rate of burning. The *fire hazard category* was chosen in preference to *FLED* because it is better able to categorise certain spaces containing mainly low heat release rate fuels (e.g. frozen meat carcasses).

3. The *S ratings* in Table 5.1 are classified in terms of *fire hazard category*. While *FHC* covers more than just the energy density of *fire load*, there is a direct link between these two parameters, as tabulated below:

Fire Hazard Category (Note 1)	Range of FLED (MJ/m²) (Note 2)	Design Value of FLED (MJ/m²) (Notes 2, 3)
1	0 - 500	400
2	501 - 1000	800
3	1001 - 1500	1200
4	> 1500	
Column 1	2	3

NOTES:

1. The *fire hazard category* for a given *purpose group* is given in Table 2.1.
2. *FLED* is expressed as MJ *fire load* per m² floor area and is the sum of the *fire loads* from all of the *combustible* materials divided by the floor area of the space. *Fire load* is calculated for each *combustible* material as *Fire Load* (MJ) = *Combustible* Mass (kg) x Heat of Combustion (MJ/kg).
3. Each *fire hazard category* covers a number of *purpose groups* with design (80 percentile) *fire load energy densities* of these groups lying in the range stated in column 2 of the above table. The design value of *FLED* for *fire* determination of *S rating* associated with each *fire hazard category* is also taken as the 80 percentile value of this range, in accordance with accepted practice. This design value adopted also directly covers the specific *FLED* associated with almost all *purpose group* uses which come within each *fire hazard category*.

Appendix D – SANS 10400 – Part T, Table 2: Safety Distances

TABLE 2 — SAFETY DISTANCE D (metres)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Area of openings, m^2 in elevation	Less than 5	5	7,5	10	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	330	350	370	390	410	430	450	500 or more
Occupancy class Low fire load where the fire load in a division does not exceed 25 kg/m^2 (timber equivalent) A1; A2; A3; A4; A5; B3; C2; D3; D4; E1; E2; E3; G1; H1; H2; H3; H4; J3; J4	1,0	1,5	2,0	2,4	3,8	4,5	5,0	5,3	5,5	5,7	5,9	6,1	6,2	6,3	6,4	6,5	6,6	6,7	6,8	6,9	6,9	7,0	7,1	7,1	7,2	7,2	7,4
Moderate fire load where the fire load in a division is between 25 kg/m^2 and 50 kg/m^2 (timber equivalent) B2; C1; D2; F1; F2; F3; J2	1,5	2,0	2,2	2,5	4,6	5,5	6,0	6,4	6,7	7,0	7,2	7,4	7,5	7,7	7,8	8,0	8,1	8,2	8,3	8,4	8,5	8,5	8,6	8,7	8,8	8,8	9,0
High fire load where the fire load in a division exceeds 50 kg/m^2 (timber equivalent) B1; D1; J1	2,0	2,7	3,5	3,7	6,2	7,3	8,0	8,6	9,0	9,3	9,6	9,9	10,1	10,3	10,5	10,6	10,8	10,9	11,1	11,2	11,3	11,4	11,5	11,6	11,7	11,8	12,0

Intermediate values from Column 3 to 28 may be interpolated.
The values contained in Column 4 to 28 approximate to those calculated using the following formulae:

Low fire load : $D = 2{,}75 \times \text{Log } A - \sqrt{\frac{1}{A}}$

Moderate fire load : $D = 3{,}25 \times \text{Log } (A - 3) - \sqrt{\frac{1}{A}}$

High fire load : $D = 2{,}25 \times \text{Log } (A^2 - 5) - \sqrt{\frac{5}{A}}$

Where A = the total area of window or other openings on one elevation of the division
D = the safety distance

Commentary: *In Table 2 the terms "low fire load", "moderate fire load" and "high fire load" are used. These refer in each case to the amount of combustible material available in a particular occupancy and thus imply the degree of intensity of any fire when fully developed and also the duration of any fire which might occur in the occupancy in question. They have nothing to do with the ease of starting a fire or the degree of danger due to smoke or poisonous fumes that would be implied by the terms low, moderate or high fire hazard.*

In the definition of "fire load" the calorific values referred to can be taken from the relevant tables contained in recognized handbooks.

The unit fire load can be expressed in calorific values (MJ/m^2) or as timber equivalent (kg/m^2). The conversion factor from megajoules per square metre to kilograms per square metre is 0,056 and from kilograms per square metre to megajoules per square metre, is 18.

Appendix E – C/AS1 – Table 2.2: Occupant Densities

Table 2.2: Occupant Densities
Paragraphs 2.3.3 and 2.3.7

Activity	Occupant density (Users/m²) (see **Note 1**)
CROWD ACTIVITIES	
Airports – baggage claim	0.5
Airports – concourses	0.1
Airports – waiting areas, check in	0.7
Area without seating or aisles	1.0
Art galleries, museums	0.25
Bar sitting areas	1.0
Bar standing area	2.0
Bleachers, pews or similar bench type seating	2.2 users per linear metre
Classrooms	0.5
Dance floors	1.7
Day care centres	0.25
Dining, beverage and cafeteria spaces	0.8
Exhibition areas, trade fairs	0.7
Fitness centres	0.2
Gymnasia	0.35
Indoor games areas/bowling alleys, etc	0.1
Libraries – stack areas	0.1
Libraries – other areas	0.15
Lobbies and foyers	1.0
Mall areas used for assembly purposes	1.0
Reading or writing rooms and lounges	0.5
Restaurants, dining rooms and lounges	0.9
Shop spaces and pedestrian circulation areas including malls and arcades	0.3
Shop spaces for furniture, floor coverings, large appliances, building supplies and manchester	0.1
Showrooms	0.2
Space with fixed seating	as number of seats (see **Note 2**)
Space with loose seating	1.3
Spaces with loose seating and tables	0.9
Stadia and grandstands	1.8
Stages for theatrical performances	1.3
Standing space	2.6
Swimming pools (water surface area)	0.2
Swimming pool surrounds and seating	0.35
Teaching laboratories	0.2
Vocational training rooms in schools	0.1

Table 2.2: Occupant Densities *(continued)*

Activity	Occupant density (Users/m²) (see **Note 1**)
SLEEPING ACTIVITIES	
Bedrooms Bunkrooms Detention quarters Dormitories, hostels Halls and *wharenui* (**Note 5**) Wards containing more than two beds	as number of beds (see **Note 2**)
WORKING BUSINESS AND STORAGE ACTIVITIES	
Aircraft hangars	0.02
Bulk storage (e.g. solid stacked)	0.01
Commercial laboratories, laundries	0.1
Computer rooms (not used as classrooms for training)	0.04
Factory space in which layout and normal use determines the number of people using it in working hours	as approved (see **Note 3**)
Heavy industry	0.03
Interview rooms	0.2
Kitchens	0.1
Manufacturing and process areas, staffrooms	0.1
Offices and staffrooms	0.1
Personal service facilities	0.2
Reception areas	0.1
Workrooms, workshops	0.2
Warehouse storage (e.g. racks and shelves)	0.03
INTERMITTENT ACTIVITIES	(see **Note 4**)
Boiler rooms, plant rooms, service units and maintenance workshops	0.03
Parking *buildings*, garages	0.02
Exitways, enclosed corridors, lifts (no occupants counted)	0.0
Laundry and house keeping facilities	0.2
Storage	0.02
Toilets and subordinate spaces (no occupants counted)	0.0

Notes:

1. The floor area to be used shall be the total *firecell* floor area including that occupied by internal partitions and *fixtures*. The occupant densities in this table already allow for a proportion of floor area, appropriate to the activity, being occupied by furniture, partitions, *fixtures* and associated equipment.
2. For fixed seating and beds, the number of seats or beds is used instead of an occupant density (users per m²).
3. In such cases, the *occupant load* must be specified when seeking a *building consent*. Future increase in numbers shall be treated as a change of use.
4. Spaces for intermittent activities (*purpose groups* IE, IA, ID), are normally not assessed for *occupant load*. It is assumed that the occupation is temporary and by people who would already have been included in the *occupant load* of another space. The figures given in the table apply where people are specifically employed to perform the functions for which the spaces are provided.
5. For halls and *wharenui*, the maximum *occupant load* is determined by the *fire safety precautions* and the escape capacity. See Paragraphs 3.3.2 h), 3.4.2 e), 6.7.2 and 6.7.9.

Appendix F – SANS 10400 – Part A, Table 2: Design Population

A21 POPULATION

(1) The population of any room or storey or portion thereof shall be taken as the actual population of such room, storey or portion thereof where such population is known or, where such population is not known, the population shall be calculated from the criteria given in Table 2.

(2) In the case of any occupancy classified as F1, where the total floor area is more than 500 m², that portion of the floor area that is in excess of 500 m² shall, for the purposes of calculation of the population, be reduced by an amount of 20 %.

TABLE 2 — DESIGN POPULATION

72 Substitute Table 2 with the following table:

1	2
Class of occupancy of room or storey or portion thereof	**Population**
A1, A2, A4, A5 CS/CL/CO	Number of fixed seats or 1 person per m² if there are no fixed seats BEWOONO.25/m² – 2.6/m²
E1, E3, H1, H3, H4 SLEEPING PG's	2 persons per bedroom 2/BED
E4 SC/SO	16 persons provided that the total number of persons per room is not more than 4 2/BED
H5 S.A	16 persons per dwelling unit provided that the total number of persons per room is not more than 4 2/BED.
G1 WH OFFICES	1 person per 15 m² (0,1) 0,1/m² (10/m²)
J1, J2, J3, J4 WORKING PG's	1 person per 50 m² (0,02) – 0,01; 0,02; 0,03
C1, E2, F1, F2 CS, SCSO, CM	1 person per 10 m² (0,1) – 0,1; 2/BED; 0,3
B1, B2, B3, D1, D2, D3 WH, WF, WM, WL	1 person per 15 m² (0,07) – 0,03; 0,1; 0,2
C2, F3 CMZ, 4	1 person per 20 m² (0,05) 0,7; 0,03
A3, H2 CS, SA	1 person per 5 m² (0,2) 0,5; 2/BED

SD, SA, SC SP, SH

Appendix G – SANS 10400 – Part T, Table 3: Maximum Division Area, m^2

TABLE 3 — MAXIMUM DIVISION AREA, m²

1	2	3	4
Occupancy	No fixed automatic fire extinguishment installation	With fixed automatic fire extinguishment installation	
		1 storey	2 storeys and over
*E1, *E2, *E3	1 250	1 250	1 250
A2, B2, B3, C1, C2, G1	5 000	No limit	10 000
A4, A5, D3, J3, J4	No limit	No limit	No limit
All other occupancies	2 500	No limit	5 000

*Maximum division area on any storey and all such divisions shall be interconnected.

Appendix H – C/AS1 – Table 4.1: Fire Safety Precautions: Key to Table References

Table 4.1: Fire Safety Precautions
Key to table references

Amend 5 Oct 2005

Part 3	Paragraphs 3.1.5, 3.13.1 and 3.19.2
Part 4	Paragraphs 4.3, 4.3.1, 4.3.3, 4.4.1, 4.5.2, 4.5.3, 4.5.4, 4.5.7, 4.5.8, 4.5.9, 4.5.10, 4.5.13, 4.5.14, 4.5.15, 4.5.19
Part 5	Paragraphs 5.5.1, 5.6.6, 5.6.8, 5.9.4 (c)
Part 6	Paragraphs 6.2.1, 6.4.1, 6.7.1, 6.8.1, 6.8.5, 6.8.6, 6.10.1, 6.11.1, 6.15.1, 6.19.9, 6.21.2, 6.23.1 (d), 6.23.2, 6.23.3
Part 8	Paragraphs 8.2.1, 8.2.2, 8.2.3
Appendix A	Paragraphs A1.1.1 and A1.1.2

Amend 4 Oct 2005

Amend 5 Oct 2005

Fire safety precautions

Amend 4 Oct 2005

Type	Description
1	Domestic smoke alarm system.
2	Manual fire alarm system.
3	Automatic fire alarm system with heat detectors and manual call points.
4	Automatic fire alarm system with smoke detectors and manual call points.
5	Automatic fire alarm system with modified smoke/heat detection and manual call points.
6	Automatic fire sprinkler system with manual call points.
7	Automatic fire sprinkler system with smoke detectors and manual call points.
8	Voice communication system.
9	Smoke control in air handling system.
10	Natural smoke venting.
11	Mechanical smoke extract.
12	No Type 12 currently specified.
13	Pressurisation of safe paths.
14	Fire hose reels.
15	Fire Service lift control.
16	Visibility in escape routes.
17	Emergency electrical power supply.
18	Fire hydrant system.
19	Refuge areas.
20.	Fire systems centre.

Amend 7 Nov 2008

Special applications

a Not required where:
- i) the *escape routes* serve an *occupant load* of no more than 50 in *purpose groups* CS (excluding *early childhood centres*), CM, WL, WM, WH and WF, or
- ii) the *escape routes* are for *purpose group* SA and serve no more than 10 beds, (or 20 beds for trampers huts, see Paragraph 6.20.6), or
- iii) exit doors from *purpose group* SA and SR *firecells* open directly onto a *safe place* or an external *safe path* (see Paragraph 3.14).

Amend 4 Oct 2005

b Where only a single *escape route* is available, no less than a Type 4 alarm is required. See Paragraph 3.15.3 for situations where sprinklers are required.

c Required where Fire Service hose run distance, from the Fire Service vehicular access (see Paragraph 8.1.1) to any point on any floor, is greater than 75 m.

e The smoke detection element is Type 5 within *firecells* containing sleeping accommodation. (See Appendix A for description of Type 5.)

f A direct connection to the Fire Service is not required provided a telephone is installed and freely available at all times to enable 111 calls to be made.

Amend 7 Nov 2008

Note:
The numbered references are more fully explained in Appendix A. Throughout Table 4.1 dark shading identifies where sprinklers are required.

Amend 7 Nov 2008

Appendix I – C/AS1 – Table 4.1: Fire Safety Precautions: (up to 100 people)

Table 4.1/1: Fire safety precautions for active purpose group firecells
Occupant load 100

Purpose group	FHC	Escape height: 0 m (or single floor)	<4 m (or two floors)	4 m to <10 m	10 m to <25 m	25 m to <34 m	34 m to <46 m	46 m to <58 m	over 58 m
CS	1	F0	F45	F45	F45	F30	F45	F45	F60
	2	F0	F60	F60	F60	F45	F45	F60	F90
	3	F0	F60	F60	F90	F45	F60	F60	F90
		2af 18c 16	2af 18c 16	3b 9 16 18c	4 9 16 18	6 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 17 18 19 20
CM	2	F0	F60	F60	F60	F45	F45	F60	F90
(Note 5)	4	F0	F30	F30	F45	F45	F60	F60	F90
		2af 18c 16	2af 18c 16	6 18c 16	3b 9 16 18c	6 9 16 18c	3b 9 15 16 18	6 9 15 16 18	6 9 13 15 16 18 20	7 9 13 15 16 18 20	7 9 13 15 16 17 18 19 20
WL	1	F0	F45	F45	F45	F30	F45	F45	F60
WM	2	F0	F60	F60	F60	F45	F45	F60	F90
WH	3	F0	F60	F60	F90	F45	F60	F60	F90
(Note 5)	4	F0	F30	F30	F45	F45	F60	F60	F90
		2af 18c 16	2af 18c 16	6 18c 16	3b 16 18c	6 16 18c	3b 15 16 18	6 15 16 18	6 15 16 18	6 9 15 16 18	7 9 13 15 16 18 19 20
WF	4	F0	F30	F30	F45	F45	F60	F60	F90
		3af 18c 16	6 18c 16	6 16 18c	6 15 16 18	6 15 16 18	6 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18 19 20
Column		1	2	3	4	5	6	7	8

Notes:

1. **Use of table:** Refer to Paragraph 4.4 for instructions on using this table to determine the *fire safety precautions* in *firecells*.
2. **Adjoining firecells having a F0 rating:** Paragraph 6.2.1 requires adjoining *firecells* to be separated by *fire separations* with *FRR* no less than 30/30/30.
3. **Intermediate floors:** Where a *firecell* contains *intermediate floors* a *FRR* shall apply to the *intermediate floors* and supporting elements, and smoke control systems Type 9 and either Type 10 or Type 11, are required (see Paragraphs 4.5.16 to 4.5.18, 6.14.3 and 6.21.5 to 6.22.14).
4. **Car parking:** Refer to Paragraphs 6.10.3 to 6.10.6 for car parking provisions within *buildings*.
5. **Sprinklers:** Refer to Paragraphs 5.6.12 and 5.6.13 for concessions for *FHC* 4.
6. **Visibility in escape routes:** Is specified in NZBC Clause F6.

Amend 7 Nov 2008 | Amend 7 Nov 2008 | Amend 7 Nov 2008 | Amend 7 Nov 2008 | Amend 4 Oct 2005 | Amend 7 Nov 2008

Appendix J – C/AS1 – Table 4.1/2: Fire Safety Precautions: (101 to 500 people)

Table 4.1/2: Fire safety precautions for active purpose group firecells
Occupant load 101 to 500

Purpose group	FHC	Escape height: 0 m (or single floor)	<4 m (or two floors)	4 m to <10 m	10 m to <25 m	25 m to <34 m	34 m to <46 m	46 m to <58 m	over 58 m
CL	1	F0	F45	F45	F45	F30	F45	F45	F60
(Note 7)	2	F0	F60	F60	F60	F45	F45	F60	F90
	3	F0	F60	F60	F90	F45	F60	F60	F90
		3f 16 18c	3f 16 18c	3b 9 16 18c	4 9 16 18	6 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 17 18 19 20
CM	2	F0	F60	F60	F60	F45	F45	F60	F90
(Note 5)	4	F0	F30	F30	F45	F45	F60	F60	F90
		3f 16 18c	3f 16 18c	6 16 18c	3b 9 16 18c	6 9 16 18c	3b 9 15 16 18	6 9 15 16 18	6 9 13 15 16 18	7 9 13 15 16 18 20	7 9 13 15 16 18 20	7 9 13 15 16 17 18 19 20
WL	1	F0	F45	F45	F45	F30	F45	F45	F60
WM	2	F0	F60	F60	F60	F45	F45	F60	F90
WH	3	F0	F60	F60	F90	F45	F60	F60	F90
(Note 5)	4	F0	F30	F30	F45	F45	F60	F60	F90
		3f 16 18c	3f 16 18c	6 16 18c	3b 16 18c	6 16 18c	3b 15 16 18	6 15 16 18	6 15 16 18	6 9 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18 19 20
WF	4	F0	F30	F30	F45	F45	F60	F60	F90
		3f 16 18c	6 16 18c	6 16 18c	6 15 16 18	6 15 16 18	6 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18 19 20
Column		1	2	3	4	5	6	7	8

Notes:

1. **Use of table:** Refer to Paragraph 4.4 for instructions on using this table to determine the *fire safety precautions* in *firecells*.
2. **Adjoining firecells having a F0 rating:** Paragraph 6.2.1 requires adjoining *firecells* to be separated by *fire separations* with *FRR* no less than 30/30/30.
3. **Intermediate floors:** Where a *firecell* contains *intermediate floors* a *FRR* shall apply to the *intermediate floors* and supporting elements, and smoke control systems Type 9 and either Type 10 or Type 11, are required (see Paragraphs 4.5.16 to 4.5.18, 6.14.3 and 6.21.5 to 6.22.14).
4. **Car parking:** Refer to Paragraphs 6.10.3 to 6.10.6 for car parking provisions within *buildings*.
5. **Sprinklers:** Refer to Paragraphs 5.6.12 and 5.6.13 for concessions for *FHC* 4.
6. **Visibility in escape routes:** Is specified in NZBC Clause F6.
7. **CL:** For *firecells*, which are not cinemas or *theatres*, with *escape height* less than 4.0 m and *occupant load* not greater than 250, Type 2f is a permitted alternative to Type 3f.

Amend 5 Oct 2005
Amend 7 Nov 2008
Amend 7 Nov 2008
Amend 4 Nov 2008

Appendix K – C/AS1 – Table 4.1/3: Fire Safety Precautions: (501 to 1000 people)

Table 4.1/3: Fire safety precautions for active purpose group firecells
Occupant load 501 to 1000

Purpose group	FHC	Escape height: 0 m (or single floor)	<4 m (or two floors)	4 m to <10 m	10 m to <25 m	25 m to <34 m	34 m to <46 m	46 m to <58 m	over 58 m
CL	1	F0	F45	F45	F30	F30	F45	F45	F60
	2	F0	F60	F60	F30	F45	F45	F60	F90
	3	F0	F60	F60	F45	F45	F60	F60	F90
		4 16 18c	4 16 18c	4 9 16 18c	7 9 16 18	7 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 17 18 19 20
CM	2	F0	F60	F60	F30	F45	F45	F60	F90
(Note 5)	4	F0	F30	F30	F45	F45	F60	F60	F90
		4 16 18c	4 16 18c	6 16 18c	4 9 16 18c	6 9 16 18c	7 9 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18 20	7 9 13 15 16 18 20	7 9 13 15 16 17 18 19 20
WL	1	F0	F45	F45	F30	F30	F45	F45	F60
WM	2	F0	F60	F60	F30	F45	F45	F60	F90
WH	3	F0	F60	F60	F45	F45	F60	F60	F90
(Note 5)	4	F0	F30	F30	F45	F45	F60	F60	F90
		4 16 18c	4 16 18c	6 16 18c	4 16 18c	6 16 18c	7 15 16 18	7 15 16 18	7 9 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18 19 20
WF	4	F0	F30	F30	F45	F45	F60	F60	F90
		4 16 18c	6 16 18c	6 16 18c	7 15 16 18	7 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18 19 20
Column		1	2	3	4	5	6	7	8

Amend 5 Oct 2005, Amend 7 Nov 2008

Notes:

1. **Use of table:** Refer to Paragraph 4.4 for instructions on using this table to determine the *fire safety precautions* in *firecells*.
2. **Adjoining firecells having a F0 rating:** Paragraph 6.2.1 requires adjoining *firecells* to be separated by *fire separations* with *FRR* no less than 30/30/30.
3. **Intermediate floors:** Where a *firecell* contains *intermediate floors* an *FRR* shall apply to the *intermediate floors* and supporting elements, and smoke control systems Type 9 and either Type 10 or Type 11, are required (see Paragraphs 4.5.16 to 4.5.18, 6.14.3 and 6.21.5 to 6.22.14).
4. **Car parking:** Refer to Paragraphs 6.10.3 to 6.10.6 for car parking provisions within *buildings*.
5. **Sprinklers:** Refer to Paragraphs 5.6.12 and 5.6.13 for concessions for *FHC* 4.
6. **Visibility in escape routes:** Is specified in NZBC Clause F6.

Amend 4 Oct 2005

Amend 7 Jun 2008

Appendix L – C/AS1 – Table 4.1/4: Fire Safety Precautions: (over 1000 people)

Amend 4 Oct 2005

Table 4.1/4: Fire safety precautions for active purpose group firecells
Occupant load over 1000

Purpose group	FHC	Escape height: 0 m (or single floor)	<4 m (or two floors)	4 m to <10 m	10 m to <25 m	25 m to <34 m	34 m to <46 m	46 m to <58 m	over 58 m
CL	1	F0	F30	F30	F30	F30	F45	F45	F60
	2	F0	F30	F30	F30	F45	F60	F60	F90
	3	F0	F30	F30	F45	F45	F60	F60	F90
		7 16 18c	7 16 18c	7 9 16 18c	7 9 16 18	7 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 17 18 19 20
CM	2	F0	F30	F30	F30	F45	F45	F60	F90
(Note 5)	4	F0	F30	F30	F45	F45	F60	F60	F90
		7 16 18c	7 16 18c	7 9 16 18c	7 9 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18 20	7 9 13 15 16 18 20	7 9 13 15 16 17 18 19 20
WL	1	F0	F30	F30	F30	F30	F45	F45	F60
WM	2	F0	F30	F30	F30	F45	F45	F60	F90
WH	3	F0	F30	F30	F30	F45	F60	F60	F90
(Note 5)	4	F0	F30	F30	F30	F45	F60	F60	F90
		7 16 18c	7 16 18c	7 16 18c	7 15 16 18	7 15 16 18	7 9 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18 19 20
WF	4	F0	F30	F30	F45	F45	F60	F60	F90
		7 16 18c	7 16 18c	7 16 18c	7 15 16 18	7 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18	7 9 13 15 16 18 19 20
Column		1	2	3	4	5	6	7	8

Amend 7 Nov 2008

Amend 7 Nov 2008

Amend 7 Nov 2008

Notes:

1. **Use of table:** Refer to Paragraph 4.4 for instructions on using this table to determine the *fire safety precautions* in *firecells*.
2. **Adjoining firecells having a F0 rating:** Paragraph 6.2.1 requires adjoining *firecells* to be separated by *fire separations* with *FRR* no less than 30/30/30.
3. **Intermediate floors:** Where a *firecell* contains *intermediate floors* a *FRR* shall apply to the *intermediate floors* and supporting elements, and smoke control systems Type 9 and either Type 10 or Type 11, are required (see Paragraphs 4.5.16 to 4.5.18, 6.14.3 and 6.21.5 to 6.22.14).
4. **Car parking:** Refer to Paragraphs 6.10.3 to 6.10.6 for car parking provisions within *buildings*.
5. **Sprinklers:** Refer to Paragraphs 5.6.12 and 5.6.13 for concessions for *FHC* 4.
6. **Visibility in escape routes:** Is specified in NZBC Clause F6.

Amend 7 Nov 2008

Appendix M – C/AS1 – Table 4.1/5: Fire Safety Precautions for Sleeping Purpose Group Firecells: (Occupant Load 40 Maximum)

Table 4.1/5: Fire safety precautions for sleeping purpose group firecells Occupant load 40 maximum

		Escape height							
Purpose Group	FHC	0 m (or single floor)	<4 m (or two floors)	4 m to <10 m	10 m to <25 m	25 m to <34 m	34 m to <46 m	46 m to <58 m	over 58 m
SC	1	F0	F30	F30	F30	F30	F45	F45	F60
SD		7 16 18c	7 16 18c	7 16 18c	7 9 15 16 18	7 8 9 13 15 16 18 20	7 8 9 13 15 16 18 20	7 8 9 13 15 16 18 20	7 8 9 13 15 16 17 18 19 20
SA	1	F0	F45	F45	F45	F30	F45	F45	F60
(Note 5)		5af 16 18c	5f 16 18c	5 14 16 18c	5 14 15 16 18	7e 8 9 15 16 18	7e 8 9 13 15 16 18 20	7e 8 9 13 15 16 18 20	7e 8 9 13 15 16 17 18 20
SR	1	F0	F45	F45	F45	F30	F45	F45	F60
(Note 7)		1 16	1 2af 16	1 2f 16	5 14 16 18	7e 15 16 18	7e 15 16 18	7e 15 16 18 20	7e 13 15 16 18 20
Column		1	2	3	4	5	6	7	8

Notes:

1. **Use of table:** Refer to Paragraph 4.4 for instructions on using this table to determine the *fire safety precautions* in *firecells*.
2. **Adjoining firecells having a F0 rating:** Paragraph 6.2.1 requires adjoining *firecells* to be separated by *fire separations* with *FRR* no less than 30/30/30.
3. **Intermediate floors:** Where a *firecell* contains *intermediate floors* a *FRR* shall apply to the *intermediate floors* and supporting elements, and smoke control systems Type 9 and either Type 10 or Type 11, are required (see Paragraphs 4.5.16 to 4.5.18, 6.14.3 and 6.21.5 to 6.22.14).
4. **Car parking:** Refer to paragraphs 6.10.3 to 6.10.6 for car parking provisions within *buildings*.
5. **Sprinklers:** *Purpose group* SA may have an *occupant load* up to 160 beds in *firecells* with a Type 7 alarm (see Paragraph 6.7.2).
6. **Occupant load in SC and SD firecells:** The *occupant load* in a *group sleeping area firecell* is limited to 12 or 20 beds and in a *suite* to six beds (see Paragraphs 6.6.3 to 6.6.5). For *firecells* (such as an operating theatre) required to remain occupied during a *fire*, see Paragraphs 5.6.8 and 5.6.9.
7. **SR household units:** See Paragraph 6.8.6 which describes where *household units* containing upper floors may be treated as single floor *firecells*.
8. **Visibility in escape routes:** Is specified in NZBC Clause F6.

Amend 7 Nov 2008

Amend 7 Nov 2008

Amend 7 Nov 2008

Amend 4 Oct 2005

Amend 7 Nov 2008

Appendix N – SANS 10400 – Part T, Table 5: Stability of Structural Elements or Components

TABLE 5 — STABILITY OF STRUCTURAL ELEMENTS OR COMPONENTS

1	2	3	4	5	6	7
Occupancy	Class of occupancy	Stability, minutes				
		Single storey building	Double storey building	3–10 storey building	11 storeys and over	Basement in any building
Entertainment and public assembly	A1	30	60	120	120	120
Theatrical and indoor sport	A2	30	60	120	120	120
Places of instruction	A3	30	30	90	120	120
Worship	A4	30	60	90	120	120
Outdoor sport	A5	30	30	60	90	120
High risk commercial service	B1	60	60	120	180	120
Moderate risk commercial service	B2	30	60	120	120	120
Low risk commercial service	B3	30	30	90	120	120
Exhibition hall	C1	60	90	120	120	120
Museum	C2	30	60	90	120	120
High risk industrial	D1	60	90	120	180	240
Moderate risk industrial	D2	30	60	90	120	180
Low risk industrial	D3	30	30	60	120	120
Plant room	D4	30	30	60	90	120
Places of detention	E1	60	60	90	120	120
Hospital	E2	60	90	120	180	120
Other institutional (residential)	E3	60	60	120	180	120
Large shop	F1	60	90	120	180	120
Small shop	F2	30	60	120	180	120
Wholesalers' store	F3	60	90	120	120	120
Offices	G1	30	30	60	120	120
Hotel	H1	30	60	90	120	120
Dormitory	H2	30	30	60	120	120
Domestic residence	H3	30	30	60	120	120
Detached dwelling house	H4	30	30	60	NA	120
High risk storage	J1	60	90	120	180	240
Moderate risk storage	J2	30	60	90	120	180
Low risk storage	J3	30	30	90	90	120
Parking garage	J4	30	30	60	90	120

Appendix O – SANS 10400 – Part T, Table 1: Fire Resistance of External Walls

TABLE 1 — FIRE RESISTANCE OF EXTERNAL WALLS

1	2
Occupancy	Fire resistance, minutes
All occupancies except those mentioned below	30
B1, C1, D1, E1, E2, E3, F1, F3, J2 and J3	60
J1	120

Appendix P – SANS 10400 – Part T, Section TT 31: Fire Detection and Alarm Systems

TT31 FIRE DETECTION AND ALARM SYSTEMS

TT31.1 Any building containing an occupancy classified —

(a) E2 or E3, irrespective of height or floor area;

(b) F1, with a floor area of more than 500 m²; or

(c) H1 or H2, with a height of more than 8 m;

shall be equipped with a fire detection system and an emergency evacuation communication system complying with SABS 0139.

TT31.2 All occupied areas within any building which exceeds 30 m in height or contains any storey exceeding 5 000 m² in floor area, other than a building contemplated in subrule **TT31.1**, shall be equipped with a fire detection and manually activated fire alarm system and an emergency evacuation communication system complying with SABS 0139.

TT31.3 Any building classified A1, A2, C1, C2 or F1 shall have a manually activated audible alarm system in accordance with SABS 0139.

Appendix Q – C/AS1 – Table 3.3: Lengths of Open Paths and Protected Paths

Table 3.3: Lengths of Open Paths and Protected Paths
Paragraphs 1.3.4, 3.4.1 a), 3.4.2 b), d) and e), 3.4.4, 3.4.6, 3.4.8, 3.5.1, 3.5.2, 3.5.3, 3.5.6, 3.8.1, 3.9.7, 3.11.7, 3.15.1 b) and c), 3.15.5 c), 6.8.2 and Figures 3.7, 3.15 and 3.21

Type of path	Purpose groups				
	SC, SD **(Note 4)**	WF	CS, CL, CM, SA	WL, WM, WH, SR, SH	CO, IA, ID
	Maximum length (m)				
Dead end open path	18	12	18	24	36
Total open path (Note 5)	45	30	45	60	90
Protected path	45	30	45	60	90
Column 1	2	3	4	5	6

Notes:

1. Where the *occupant load* exceeds 50, there shall be two or more *escape routes* from any space.
2. In accordance with Paragraphs 3.5 and 3.11.7 *open path* lengths and horizontal *safe path* lengths (but not protected paths), may be increased by:

	SA, SR, SH	CS, CL, CM, WL, WM, WH, IA, ID
where heat detectors are installed	10%	20%
where sprinklers are installed	50%	100%
where smoke detectors Types 4, 5 or 7 are installed	50%	100%

3. Paragraph 3.5.6 gives the circumstances where permitted increases, in the lengths of *dead end* and total *open path* may be combined.
4. Because *purpose groups* SC and SD are required by Table 4.1 always to have sprinklers and smoke detectors, no increases in accordance with Paragraph 3.5 are permitted for those *purpose groups*.
5. Allowed only if there is more than one *escape route*, but shall include any initial *dead end* length.

Appendix R – SANS 10400 – Part T, Section TT 36: Sprinkler Systems

TT36 SPRINKLER SYSTEMS

TT36.1 (a) In addition to the requirements contained in rule **TT4** and subrule **TT26.1(b)** an approved sprinkler system shall be installed —

(i) in any building exceeding 30 m in height except where such building is exclusively of an occupancy classified G1 where the division size is not greater than 500 m², or of an occupancy classified H3;

(ii) in any basement storey which exceeds 500 m² in floor area and such storey is not naturally ventilated; and

(iii) in any other storey which exceeds 500 m² in total floor area and such storey is not provided with breakable or openable panels as contemplated in subrule **TT42.1**, suitable for smoke ventilation.

(b) Any other approved fixed means of automatic fire extinguishment may be substituted for an approved system required in terms of these rules.

(c) In the case of any strong room, record room or security vault such a system need not be provided.

TT36.2 Any concealed space, not being a roof space contemplated in subrule **TT12.5**, which has a clear height exceeding 800 mm and a total area of compartment of more than 100 m² above any ceiling or a total area of compartment of more than 300 m² below any raised floor shall be equipped with a sprinkler system.

TT36.3 Any sprinkler system shall be fitted with a twin coupling for the attachment of a fire-pump: Provided that —

(a) such coupling shall be painted lime yellow;

(b) the pressure exerted by such pump shall be not more than 1 000 kPa; and

(c) such pressure limitation shall be clearly marked on such coupling.

Appendix S – SANS 10400 – Part T, Section TT 37: Portable Fire Extinguishers

TABLE 10 — PROVISION OF PORTABLE EXTINGUISHERS

1	2
Classification of occupancies	Number of portable fire extinguishers relative to floor area
B1, D1, D2 J1, J2, J3	1 per 100 m²
A1, A2, A3, B2, C1, C2, D3, E1, E2, E3, F1, F2, F3, G1, H1, H2	1 per 200 m²
A4, A5, B3, D4, H3, J4	1 per 400 m²

TT37.5 The type of fire extinguisher shall, for the occupancy in which it is installed, have a capacity or mass rating as follows:

(a) For an occupancy classified A1, A2, A3, A4, A5, E1, E2, E3, F1, F2, F3, G1, H1, H2 or H3:

(i)	Water type	9 ℓ
(ii)	Foam type	9 ℓ
(iii)	Carbon dioxide type	4,5 kg
(iv)	Dry chemical type	4,5 kg
(v)	Halogenated hydrocarbon type	2,5 kg

(b) For an occupancy classified B1, B2, B3, C1, C2, D1, D2, D3, D4, J1, J2, J3 or J4:

(i)	Water type	9 ℓ
(ii)	Foam type	9 ℓ
(iii)	Carbon dioxide type	9 kg
(iv)	Dry chemical type	9 kg
(v)	Halogenated hydrocarbon type	5 kg

Appendix T – C/AS1 – Table 3.1: Number of Escape Routes from a Floor Level

Table 3.1: Number of Escape Routes from a Floor Level
Paragraphs 3.2.2, 3.3.2 b), 3.16.1 and 3.16.5 a)

Occupant load on the floor being considered (Note 1)		Minimum number of escape routes
Purpose groups SC, SD		
Up to	50 beds	2
Over	50	2 plus **(Note 2)**
Purpose groups SA, SR		
Up to	100 beds	2
Over	100	2 plus **(Note 3)**
Purpose groups CS, CL, CO, CM, WL, WM, WF, WH, IA, ID		
Up to	500	2 **(Note 4)**
Up to	1000	3
Up to	2000	4
Up to	4000	5
Up to	7000	6
Up to	16,000	8
Over	16,000	8 plus **(Note 5)**

Notes:

1. Guidance on determining *occupant load* is given in Part 2. Special conditions applying to crowd and sleeping *purpose groups* are contained in Paragraph 3.16.
2. Plus 1 for every 100 beds, or part thereof over 50.
3. Plus 1 for every 100 beds, or part thereof over 100.
4. Special cases allowing single *escape routes* are given in Paragraph 3.15.
5. Plus 1 for every 5000, or part thereof increase in *occupant load,* above 16,000.

Appendix U – SANS 10400 – Part T, Section TT 21 & Table 9: Width of Escape Routes

TT21. WIDTH OF ESCAPE ROUTES

TT21.1

(a) The population of any room or storey or portion thereof shall be the actual number of persons in such room, storey or portion thereof during normal use or shall be calculated from the criteria given in regulation **A21**.

(b) Where more than one escape route discharges to a common component the width of such common component and any following components situated along the direction of egress shall be calculated by taking into account the population discharging into such common component: Provided that in the case of any stairway, only the population of the most heavily populated storey served thereby shall be deemed to discharge into such stairway.

TT21.2

In any building the width of any escape route to be provided in respect of any room, storey or portion thereof shall be not less than that given in Table 9 for the population concerned: Provided that —

(a) no individual escape route shall be designed for a population of more than 190 persons;

(b) where there are two or more emergency routes one such route shall be discounted in determining the widths required for the remainder.

TABLE 9 — WIDTH OF ESCAPE ROUTES

1	2
Maximum number of persons	Minimum width, mm
120	1 100
130	1 200
140	1 300
150	1 400
160	1 500
170	1 600
180	1 700
190	1 800

TT21.3

The aggregate width of escape routes shall be so distributed that the minimum widths of individual routes serving any room, storey or portion thereof shall be as nearly equal to each other as is practicable.

Appendix V – C/AS1 – Table 3.2: Width of Escape Routes

Table 3.2: Width of Escape Routes
Paragraphs 3.3.2, 3.3.2 h), j) and k), 3.3.6 b), 3.9.12 e)

	Purpose groups		
	CS, CL, CM, SA, SR, WL, WM, WH, WF, IA, ID	SC, SD	CO **(Note 9)**
	Minimum width of individual escape routes (mm)		
Horizontal travel	850 **(Notes 1, 2, 3, 5)**	1200	1000
Vertical travel **(Notes 7 and 8)**	1000 **(Note 2)**	1500 **(Note 4)**	1200 **(Note 5)**
	Required total combined width of all escape routes (Note 6) (mm per person)		
Horizontal travel	7	8	2
Vertical travel **(Notes 7 and 8)**	9	10	3
Column 1	2	3	4

Notes:

1. The width of an *escape route* within an *exitway*, excluding the entry door (see Paragraph 3.3.2 a)), shall be no less than 1000 mm.
2. Where there is no requirement to provide for *people with disabilities*, and the *occupant load* is less than 50, widths of *escape routes* when an *open path*, may be reduced to 700 mm for horizontal travel, and 850 mm for vertical travel.
3. For gangways between fixed storage in other than public areas, width may be reduced to 530 mm.
4. These widths apply only to *escape routes* from sleeping areas, but the width from column 2 may be used for *escape routes* serving only:
   a) Occupants of non-sleeping areas, or
   b) Sleeping areas where the number of beds is less than 10 and the occupants are active and can be directed by staff, or
   c) Occupants who are active, ambulant and require no assistance to escape.
5. For areas of fixed or loose seating:
   a) *Escape routes* shall comply with the requirements of Paragraphs 3.9.3 and 3.9.4 for aisles and width between rows.
   b) From the termination of an aisle the minimum *escape route* width shall be the greater of the aisle width or the width required by Paragraph 3.3.2.
6. The width calculated on *occupant load* determines any extra width required, but in no case shall the width be less than the minimum for individual *escape routes*.
7. For limitations on width of the *escape route* in *stairways* and where the *escape height* exceeds 34 m, see Paragraphs 3.3.3 and 3.3.4.
8. Ramps with a slope of not more than 1:8 may be regarded as horizontal travel.
9. The widths given in column 4 apply only to *escape routes* wholly in the open air. Any enclosed part of the *escape route* shall be the width determined for CL using column 2 and that width shall not be reduced even if the *escape route* subsequently passes to the open air.

Appendix W – SANS 10400 – Part T, Table 7: Required Classifications for Fitted Floor Coverings

TABLE 7 — REQUIRED CLASSIFICATIONS FOR FITTED FLOOR COVERING

1	2	3		4		5	6
Class of occupancy	Basement of building of any height	Single and double storey buildings		Building exceeding two storeys		Building of any height	
	Any floor area except that contemplated in column 5 or 6					Feeder routes	Emergency routes
	USP or SP	USP	SP	USP	SP		
A1	2	3	3	3	3	2	1
A2	2	3	3	3	3	2	1
A3	2	3	3	3	3	2	1
A4	2	3	3	3	4	2	1
B1	2	3	4	3	4	3	1
B2	2	4	5	3	4	3	1
B3	3	4	5	4	5	3	1
C1	3	3	4	3	4	2	1
C2	3	3	4	3	4	2	1
D1	NC	NC	NC	NC	NC	NC	NC
D2	2	4	5	3	4	3	1
D3	2	4	5	4	5	3	1
D4	NC	NC	NC	NC	NC	NC	NC
E1	NC	3	3	3	3	2	1
E2	NC	3	3	3	3	2	1
E3	NC	3	3	3	3	1	1
F1	3	4	5	3	4	2	1
F2	3	4	5	3	4	2	1
F3	3	4	5	3	4	2	1
G1	3	4	5	4	5	3	1
H1	1	4	5	4	5	3	1
H2	1	4	5	2	4	3	1
H3	1	5	5	3	4	3	1
J1	NC	NC	NC	NC	NC	NC	NC
J2	NC	NC	3	NC	3	2	1
J3	2	3	4	2	3	2	1
J4	NC	NC	NC	NC	NC	NC	NC

NC = Non-combustible material only.
SP = Protected by a sprinkler system.
USP = Not protected by a sprinkler system.

Appendix X – SANS 10400 – Part T, Table 8: Required Classifications for Wall Finishes

TABLE 8 — REQUIRED CLASSIFICATIONS FOR WALL FINISHES

1	2	3		4		5	6
Class of occupancy	Basement of building of any height	Single and double storey buildings		Building exceeding two storeys		Building of any height	
	Any wall area except that contemplated in column 5 or 6					Feeder routes	Emergency routes
	SP	USP	SP	USP	SP		
A1	1	3	3	3	3	2	1
A2	1	3	3	3	3	2	1
A3	1	3	3	3	3	2	1
A4	1	4	4	3	4	2	1
B1	2	3	4	3	4	3	1
B2	2	3	4	3	4	3	1
B3	3	4	5	4	5	3	1
C1	3	3	4	3	4	2	1
C2	3	3	4	3	4	2	1
D1	NC	NC	NC	NC	NC	NC	NC
D2	2	3	4	3	4	3	1
D3	2	4	5	4	5	3	1
D4	NC	NC	NC	NC	NC	NC	NC
E1	NC	2	2	2	2	2	1
E2	NC	2	2	2	2	2	1
E3	NC	2	2	2	2	2	1
F1	3	2	3	2	3	2	1
F2	3	2	3	2	3	2	1
F3	3	2	3	2	3	2	1
G1	3	4	5	4	5	3	1
H1	Not permitted	3	5	3	5	3	1
H2		3	4	2	4	3	1
H3		4	5	3	4	3	1
J1	NC	NC	NC	NC	NC	NC	NC
J2	NC	NC	3	NC	3	2	1
J3	2	3	4	2	3	2	1
J4	NC	NC	NC	NC	NC	NC	NC

NC = Non-combustible material only.
SP = Protected by a sprinkler system.
USP = Not protected by a sprinkler system.

Appendix Y – C/AS1 – Table 6.2: Requirements for Interior Surface Finishes and Suspended Flexible Fabrics to Inhibit Fire Spread

Table 6.2: Requirements for Interior Surface Finishes and Suspended Flexible Fabrics to Inhibit Fire Spread
Paragraphs 6.18.2 d), 6.20.2, 6.20.5, 6.20.7, 6.20.16, 6.20.20 and 6.20.21

Building elements	Purpose group or location (Note 1)	Maximum permitted index			Row
		SFI	SDI	FI	
Walls, ceilings (Note 2)	*Exitways* in all *purpose groups*. Sleeping areas in *purpose groups* SC and SD.	0	3	-	1
	All *occupied spaces* in *purpose groups* CS and CL excluding *exitways* (see also Paragraph 6.20.7). All *occupied spaces* in *purpose group* CM where the *occupant load* is greater than 50. Sleeping areas in *purpose group* SA (see also Paragraph 6.20.6 for trampers' huts).	2	5	-	2
	Passageways, corridors and *stairways* not being part of an *exitway* in all *purpose groups* except SH and SR.	7	5	-	3
	Minimum requirement for all *occupied spaces* in all *purpose groups* except within *household units* in *purpose groups* SR and SH.	5 or 9	10 8	- -	4
	Within individual *household units* in *purpose groups* SR and SH.	Nil requirement			5
Flooring (coverings)	*Exitways*. Any *occupied space* in *purpose groups* SC and SD.	*Non-combustible*, or have low radius of effects of ignition (see Paragraph 6.20.8).			6
Ducts for *HVAC* systems	Internal surfaces.	0	3	-	7
	External surfaces.	7	5	-	8
Acoustic treatment and pipe insulation	Within air-handling plenum in *purpose groups* SC, SD, SA and SR.	7	5	-	9
Suspended flexible fabrics	*Exitways* serving *purpose groups* SC, SD, SA, SR and CO.				
	All *occupied spaces* in *purpose groups* CS and CL including *exitways*.				
	All *occupied spaces* including *exitways* in *purpose group* CM where *occupant load* is greater than 50.	-	-	12	10
	Underlay to exterior cladding or roofing when exposed to view in *occupied spaces* in *purpose groups* SC, SD, SA, WL, WM, WH, WF, CO, CM, CS, CL and IE.			5	11
Membrane structures	*Purpose groups* CM, CS and CL.	-	-	12	12
Column 1	2		3		

Amend 7 Nov 2008

Key: **SFI = spread of flame index**
SDI = smoke developed index
FI = flammability index
(The smaller the index number the more stringent the requirement)

Notes:

1. For the purposes of this table, the term *"occupied spaces"* means a space that can be expected to be occupied during normal use of the *building* by its intended occupants. It does not include *concealed spaces* or ceiling cavities which may be accessed only through a hatch, or plant rooms and the like occupied only for maintenance purposes.
2. **Sprinklered firecells:** see Paragraph 6.20.5 for reduced requirements in sprinklered *firecells*.

Appendix Z – Fire Safety Index Calculations – PG: WL (0m, ≤ 50 occupants)

Purpose Group			WL	B3	D3	J3	G1
Occupants			50	50	50	50	50
Density			0.1	1/15	1/15	1/50	1/15
Area	m^2		500	750	750	2500	750
Alarm			2af				
Height	m		0	0 m	0 m	0 m	0 m
Storeys			1	Single	Single	Single	Single
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Working Purpose Groups							
Moderate Risk Industrial	5						
Moderate Risk Commercial	5						
Moderate Risk Storage	5						
Low Risk Commercial	5		0.166	0.166			
Low Risk Industrial	5				0.166		
Low Risk Storage	5					0.166	
Offices	5						0.166
BU2 - Building Escape Height		**0.0663**					
>58m	0						
$46m < H_e \leq 58m$	1						
$34m < H_e \leq 46m$	2						
$25m < H_e \leq 34m$	3						
$10m < H_e \leq 25m$	4						
$4m < H_e \leq 10m$	5						
< 4m	5						
0m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
>1000	1						
501 < Occ. No. ≤ 1000	2						
101 < Occ. No. ≤ 500	3						
51 < Occ. No. ≤ 100	4						
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**					
4	0						
3	1						
2	3		0.1989	0.1989	0.1989	0.1989	0.1989
1	5						
Total Building Use Score (BUS)		**0.1879**	**0.8069**	**0.8069**	**0.8069**	**0.8069**	**0.8069**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
0	0		0.000				
15	1						

Purpose Group			WL	B3	D3	J3	G1
Occupants			50	50	50	50	50
30	2			0.3008	0.3008	0.3008	0.3008
45	3						
60	4						
>60	5						
A2 - Structural Fire Endurance Rating		**0.0962**					
0	0						
30	1			0.0962	0.0962		0.0962
60	2		0.1924			0.1924	
90	3						
120	4						
>120	5						
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0		0.000	0.000	0.000	0.000	0.000
Type 2 Alarm - Manual Alarm	2						
Type 3 Alarm - Automatic Alarm with Heat Detectors	3						
Type 5 Alarm - Automatic Alarm with Heat and Local Smoke Detectors	4						
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5						
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000	0.000	0.000	0.000	
Manual Shutdown	2						
Automatic Shutdown	5						0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000				
Manual Natural Ventilation	1						0.020
Manual Mechanical Extraction	2						
Automatic Natural Ventilation	4			0.080	0.080	0.0804	
Automatic Mechanical Ventilation	5						
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
Yes	5						
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
Dry Pipe Sprinkler System	4						
Wet Pipe Sprinkler System	5						
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
Class C	2						

Purpose Group			WL	B3	D3	J3	G1
Occupants			50	50	50	50	50
Class B	4						
Class A	5						
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Blanket	1						
Fire Extinguisher	3						
Fire Hose Reel	4						
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
Emergency Power Supply	5						
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
Voice Communication System	3						
Fire Systems Centre	4						
Voice Communication System & Fire Systems Centre	5						
G1 - Alerting		**0.0266**					
Type							
No means for alerting the Fire Service	0						
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
Direct Connection via Security Firm	4						
Direct Connection to Fire Service	5						
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
Yes	5						
G3 - Fire Fighting Access		**0.0221**					
Type							
No Hydrant System or Hose Run > 75m	0						
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884		0.0884
Fire Hydrant System	5					0.1105	
H1 - Number of Escape Routes		**0.0196**					
Required Number							
1	1		0.0196				
2	2			0.0392	0.0392	0.0392	0.0392
3	3						
≥ 4	4						
H2 - Width of Escape Routes		**0.0196**					

Purpose Group			WL	B3	D3	J3	G1
Occupants			50	50	50	50	50
Width							
Width < 1000 mm	0		0.000				
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2						
4500 mm ≤ Width < 9000mm	3						
9000mm ≤ Width	5						
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
None	0			0.000	0.000	0.000	0.000
At Final Exit	2		0.0102				
Exitways	4						
Open Paths and Exitways	5						
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
In Staircase (< 6 persons capacity)	3						
Protected Lobby to Staircase (> 6 persons capacity)	5						
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
> 60 m	0						
45 < DEOP ≤ 60 m	1						
30 < DEOP ≤ 45 m	2						
25 < DEOP ≤ 30 m	3						
20 < DEOP ≤ 25 m	4		0.0796				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
> 140 m	0						
110 < TOP ≤ 140 m	1						
80 < TOP ≤ 110 m	2						
60 < TOP ≤ 80 m	3						
50 < TOP ≤ 60 m	4		0.0796				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
> 90 m	0						
75 < PP ≤ 90 m	1						
60 < PP ≤ 75 m	2						
45 < PP ≤ 60 m	3		0.0816				
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088	0.1088
PP ≤ 30 m	5						
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI > 0, SDI > 3, FI > 12	0						

Purpose Group			WL	B3	D3	J3	G1
Occupants			50	50	50	50	50
SFI = 0, SDI ≤ 3, FI > 12	3						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
No applied surface finishes, non-combustible surfaces	5						
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Walls and Ceilings	0						
Ceilings	1			0.0454	0.0454		0.0454
Ceilings	2					0.0908	
Walls and Ceilings (or Ceilings Only)	3		0.1362				
Walls and Ceilings	4						
Walls and Ceilings	5						
H10 - Signage		**0.0051**					
Extent							
None	0						
Fire Exit Signs	1			0.0051	0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153				
Flashing Illuminated Exit Signs	5						
Total Fire Safety Features (FSF)		**0.8116**	**0.794**	**1.078**	**1.078**	**1.242**	**1.202**
Fire Safety Index		**1.00**	**1.601**	**1.885**	**1.885**	**2.049**	**2.009**

Appendix AA – Fire Safety Index Calculations – PG: WL (0m, ≤ 100 occupants)

Purpose Group			WL	B3	D3	J3	G1
Occupants			100	100	100	100	100
Density			0.1	1/15	1/15	1/50	1/15
Area	m^2		1000	1500	1500	5000	1500
Alarm			2				
Height	m		0	0 m	0 m	0 m	0 m
Storeys			1	Single	Single	Single	Single
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Working Purpose Groups							
Low Risk Commercial	5		0.166	0.166			
Low Risk Industrial	5				0.166		
Low Risk Storage	5					0.166	
Offices	5						0.166
BU2 - Building Escape Height		**0.0663**					
0m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
51 < Occ. No. ≤ 100	4		0.0884	0.0884	0.0884	0.0884	0.0884
BU4 - Fire Hazard Category		**0.0663**					

Purpose Group			WL	B3	D3	J3	G1
Occupants			100	100	100	100	100
2	3		0.1989	0.1989	0.1989	0.1989	0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7848**	**0.7848**	**0.7848**	**0.7848**	**0.7848**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
0	0		0.000				
30	2			0.3008	0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating		**0.0962**					
0	0						
30	1			0.0962	0.0962		0.0962
60	2		0.1924			0.1924	
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0			0.000	0.000	0.000	0.000
Type 2 Alarm - Manual Alarm	2		0.2352				
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000	0.000	0.000		
Automatic Shutdown	5					0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000				
Manual Natural Ventilation	1						0.020
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804	
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024

Purpose Group			WL	B3	D3	J3	G1
Occupants			100	100	100	100	100
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884		0.0884
Fire Hydrant System	5					0.1105	
H1 - Number of Escape Routes		**0.0196**					
Required Number							
2	2		0.0392	0.0392	0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**					
Width							
Width < 1000 mm	0		0.000				
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
None	0			0.0000	0.000	0.000	0.000
At Final Exit	2		0.0102				
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
20 < DEOP ≤ 25 m	4		0.0796				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
50 < TOP ≤ 60 m	4		0.0796				

Purpose Group			WL	B3	D3	J3	G1
Occupants			100	100	100	100	100
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
45 < PP ≤ 60 m	3		0.0816				
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	1			0.0454	0.0454		0.0454
Ceilings	2					0.0908	
Walls and Ceilings (or Ceilings Only)	3		0.1362				
H10 - Signage		**0.0051**					
Extent							
Fire Exit Signs	1			0.0051	0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153				
Total Fire Safety Features (FSF)		**0.8116**	**1.049**	**1.078**	**1.078**	**1.426**	**1.202**
Fire Safety Index		**1.00**	**1.833**	**1.863**	**1.863**	**2.211**	**1.987**

Appendix AB – Fire Safety Index Calculations – PG: WL (0m, ≤ 500 occupants)

Purpose Group			WL	B3	D3	J3	G1
Occupants			500	500	500	500	500
Density			0.1	1/15	1/15	1/50	1/15
Area	m^2		5000	7500	7500	25000	7500
Alarm			3f	4, SP	4, SP	4	4, SP
Height	m		0	0 m	0 m	0 m	0 m
Storeys			1	Single	Single	Single	Single
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Working Purpose Groups							
Low Risk Commercial	5		0.166	0.166			
Low Risk Industrial	5				0.166		
Low Risk Storage	5					0.166	
Offices	5						0.166
BU2 - Building Escape Height		**0.0663**					
0m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					

Purpose Group			WL	B3	D3	J3	G1
Occupants			500	500	500	500	500
101 < Occ. No. ≤ 500	3		0.0663	0.0663	0.0663	0.0663	0.0663
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7627**	**0.7627**	**0.7627**	**0.7627**	**0.7627**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
0	0		0.000				
30	2			0.3008	0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating		**0.0962**					
30	1		0.0962	0.0962	0.0962		0.0962
60	2					0.1924	
B - Fire Alarm Type		**0.1176**					
Alarm Type							
Type 2 Alarm - Manual Alarm	2		0.235				
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5			0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
Automatic Natural Ventilation	4		0.0804	0.080	0.080	0.080	0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.00			0.0000	
Wet Pipe Sprinkler System	5			0.3565	0.3565		0.3565
D2 - Water Supply		**0.0190**					
Type							
None	0		0.00			0.000	
Class A	5			0.095	0.095		0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							

Purpose Group			WL	B3	D3	J3	G1
Occupants			500	500	500	500	500
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884		0.0884
Fire Hydrant System	5					0.1105	
H1 - Number of Escape Routes		**0.0196**					
Required Number							
2	2		0.0392				
3	3			0.0588	0.0588	0.0588	0.0588
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392				
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Exitways	4			0.0204	0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255				
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
25 < DEOP ≤ 30 m	3		0.0199				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995

Purpose Group			WL	B3	D3	J3	G1
Occupants			500	500	500	500	500
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
110 < TOP ≤ 140 m	1		0.0199				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
45 < PP ≤ 60 m	3		0.0816				
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088	0.1088
PP ≤ 30 m	5						
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Walls and Ceilings	0			0.000	0.000		0.000
Ceilings	2					0.0908	
Walls and Ceilings (or Ceilings Only)	3		0.1362				
H10 - Signage		**0.0051**					
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**0.968**	**2.307**	**2.307**	**2.064**	**2.307**
Fire Safety Index		**1.00**	**1.731**	**3.069**	**3.069**	**2.827**	**3.069**

Appendix AC – Fire Safety Index Calculations – PG: WL (0m, ≤ 1000 occupants)

Purpose Group			WL	B3	D3	J3	G1
Occupants			1000	1000	1000	1000	1000
Density			0.1	1/15	1/15	1/50	1/15
Area	m^2		10000	15000	15000	50000	15000
Height	m		0	0 m	0 m	0 m	0 m
Alarm			4	4, SP	4, SP	4	4, SP
Storeys			1	Single	Single	Single	Single
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Working Purpose Groups							
Low Risk Commercial	5		0.166	0.166			
Low Risk Industrial	5				0.166		
Low Risk Storage	5					0.166	
Offices	5						0.166
BU2 - Building Escape Height		**0.0663**					
0m	5		0.3315	0.3315	0.3315	0.3315	0.3315

Purpose Group			WL	B3	D3	J3	G1
Occupants			1000	1000	1000	1000	1000
BU3 - Occupant Numbers		**0.0221**					
>1000	1						
501 < Occ. No. ≤ 1000	2		0.0442	0.0442	0.0442	0.0442	0.0442
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7406**	**0.7406**	**0.7406**	**0.7406**	**0.7406**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
0	0		0.000				
30	2			0.3008	0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating		**0.0962**					
0	0						
30	1			0.0962	0.0962		0.0962
60	2		0.1924			0.1924	
B - Fire Alarm Type		**0.1176**					
Alarm Type							
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
Automatic Natural Ventilation	4		0.0804	0.080	0.080	0.080	0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0					0.0000	
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.3565		0.3565
D2 - Water Supply		**0.0190**					
Type							
None	0					0.000	
Class C	2		0.04				
Class A	5			0.095	0.095		0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					

Purpose Group			WL	B3	D3	J3	G1
Occupants			1000	1000	1000	1000	1000
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1			0.0266	0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133				
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
No Hydrant System or Hose Run > 75m	0			0.000	0.000		0.000
Fire Hydrant System	5		0.1105			0.1105	
H1 - Number of Escape Routes		**0.0196**					
Required Number							
3	3		0.0588				
≥ 4	4			0.0784	0.0784	0.0784	0.0784
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392				
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Exitways	4			0.0204	0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255				
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
45 < DEOP ≤ 60 m	1		0.020				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
110 < TOP ≤ 140 m	1		0.0199				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
45 < PP ≤ 60 m	3		0.0816				
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088	0.1088

Purpose Group			WL	B3	D3	J3	G1
Occupants			1000	1000	1000	1000	1000
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI > 12	3			0.0336	0.0336	0.0336	0.0336
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448				
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	2			0.0908	0.0908	0.0908	0.0908
Walls and Ceilings (or Ceilings Only)	3		0.1362				
H10 - Signage		**0.0051**					
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.960**	**2.317**	**2.317**	**2.073**	**2.317**
Fire Safety Index		**1.00**	**2.700**	**3.058**	**3.058**	**2.813**	**3.058**

Appendix AD – Fire Safety Index Calculations – PG: WL (0m, ≤ 1200 occupants)

Purpose Group			WL	B3	D3	J3	G1
Occupants			1200	1200	1200	1200	1200
Density			0.1	1/15	1/15	1/50	1/15
Area	m^2		12000	18000	18000	60000	18000
Height	m		0	0 m	0 m	0 m	0 m
Alarm			7	4, SP	4, SP	4	4, SP
Storeys			1	Single	Single	Single	Single
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Working Purpose Groups							
Low Risk Commercial	5		0.166	0.166			
Low Risk Industrial	5				0.166		
Low Risk Storage	5					0.166	
Offices	5						0.166
BU2 - Building Escape Height		**0.0663**					
0m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
>1000	1		0.0221	0.0221	0.0221	0.0221	0.0221
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7185**	**0.7185**	**0.7185**	**0.7185**	**0.7185**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
0	0		0.000				
30	2			0.3008	0.3008	0.3008	0.3008

Purpose Group			WL	B3	D3	J3	G1
Occupants			1200	1200	1200	1200	1200
A2 - Structural Fire Endurance Rating		**0.0962**					
30	1			0.0962	0.0962		0.0962
60	2		0.1924			0.1924	
B - Fire Alarm Type		**0.1176**					
Alarm Type							
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000				
Automatic Natural Ventilation	4			0.080	0.080	0.080	0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0					0.000	
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.3565		0.357
D2 - Water Supply		**0.0190**					
Type							
None	0					0.000	
Class C	2		0.038				
Class A	5			0.095	0.095		0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1			0.0266	0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133				
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000

Purpose Group			WL	B3	D3	J3	G1
Occupants			1200	1200	1200	1200	1200
G3 - Fire Fighting Access		**0.0221**					
Type							
No Hydrant System or Hose Run > 75m	0			0.000	0.000		0.000
Fire Hydrant System	5		0.1105			0.1105	
H1 - Number of Escape Routes		**0.0196**					
Required Number							
≥ 4	4		0.0784	0.0784	0.0784	0.0784	0.0784
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392				
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Exitways	4			0.0204	0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255				
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
> 60 m	0		0.000				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
> 140 m	0		0.000				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
45 < PP ≤ 60 m	3		0.0816				
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088	0.1088
PP ≤ 30 m	5						
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI > 12	3			0.0336	0.0336	0.0336	0.0336
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448				
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	2		0.0908	0.0908	0.0908	0.0908	0.0908
H10 - Signage		**0.0051**					
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.814**	**2.317**	**2.317**	**2.073**	**2.317**

Purpose Group			WL	B3	D3	J3	G1
Occupants			1200	1200	1200	1200	1200
Fire Safety Index		**1.00**	**2.532**	**3.036**	**3.036**	**2.791**	**3.036**

Appendix AE – Fire Safety Index Calculations – PG: WL (≤ 4m, ≤ 50 occupants)

Purpose Group			WL	B3	D3	J3	G1
Occupants			50	50	50	50	50
Density			0.1	1/15	1/15	1/50	1/15
Area	m^2		500	750	750	2500	750
Alarm			2af				
Height	m		< 4	3 m	3 m	3 m	3 m
Storeys			2	Double	Double	Double	Double
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Working Purpose Groups							
Low Risk Commercial	5		0.166	0.166			
Low Risk Industrial	5				0.166		
Low Risk Storage	5					0.166	
Offices	5						0.166
	5						
BU2 - Building Escape Height		**0.0663**					
< 4m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	0.1989
Total Building Use Score (BUS)		**0.1879**	**0.8069**	**0.8069**	**0.8069**	**0.8069**	**0.8069**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
30	2			0.3008	0.3008	0.3008	0.3008
45	3						
60	4		0.6016				
A2 - Structural Fire Endurance Rating		**0.0962**					
0	0						
30	1			0.0962	0.0962		0.0962
60	2					0.1924	
120	4		0.3848				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0		0.000	0.000	0.000	0.000	0.000
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184

Purpose Group			WL	B3	D3	J3	G1
Occupants			50	50	50	50	50
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000				
Manual Natural Ventilation	1						0.020
Automatic Natural Ventilation	4			0.080	0.080	0.0804	
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884		0.0884
Fire Hydrant System	5					0.1105	
H1 - Number of Escape Routes		**0.0196**					
Required Number							
2	2		0.0392	0.0392	0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**					
Width							
Width < 1000 mm	0		0.000				
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**					

Purpose Group			WL	B3	D3	J3	G1
Occupants			50	50	50	50	50
Extent (SA building occ > 100)							
None	0			0.000	0.000	0.000	0.000
Exitways	4		0.0204				
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
20 < DEOP ≤ 25 m	4		0.0796				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
50 < TOP ≤ 60 m	4		0.0796				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
45 < PP ≤ 60 m	3		0.0816				
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	1			0.0454	0.0454		0.0454
Ceilings	2						
Walls and Ceilings (or Ceilings Only)	3		0.1362			0.1362	
H10 - Signage		**0.0051**					
Extent							
Fire Exit Signs	1			0.0051	0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153				
Total Fire Safety Features (FSF)		**0.8116**	**1.618**	**1.262**	**1.262**	**1.471**	**1.202**
Fire Safety Index		**1.00**	**2.425**	**2.069**	**2.069**	**2.278**	**2.009**

Appendix AF – Fire Safety Index Calculations – PG: WL (≤ 4m, ≤ 100 occupants)

Purpose Group			WL	B3	D3	J3	G1
Occupants			100	100	100	100	100
Density			0.1	1/15	1/15	1/50	1/15
Area	m^2		1000	1500	1500	5000	1500
Alarm			2				
Height	m		< 4	3 m	3 m	3 m	3 m
Storeys			2	Double	Double	Double	Double
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					

Purpose Group			WL	B3	D3	J3	G1
Occupants			100	100	100	100	100
Working Purpose Groups							
Moderate Risk Industrial	5						
Moderate Risk Commercial	5						
Moderate Risk Storage	5						
Low Risk Commercial	5		0.166	0.166			
Low Risk Industrial	5				0.166		
Low Risk Storage	5					0.166	
Offices	5						0.166
	5						
BU2 - Building Escape Height	5	**0.0663**					
< 4m			0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
51 < Occ. No. ≤ 100	4		0.0884	0.0884	0.0884	0.0884	0.0884
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7848**	**0.7848**	**0.7848**	**0.7848**	**0.7848**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
30	2			0.3008	0.3008	0.3008	0.3008
60	4		0.6016				
A2 - Structural Fire Endurance Rating		**0.0962**					
0	0						
30	1			0.0962	0.0962		0.0962
60	2					0.1924	
120	4		0.3848				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0			0.000	0.000	0.000	0.000
Type 2 Alarm - Manual Alarm	2		0.2352				
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000				
Manual Natural Ventilation	1						0.020
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804	
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							

Purpose Group			WL	B3	D3	J3	G1
Occupants			100	100	100	100	100
None	0		0.000	0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884		0.0884
Fire Hydrant System	5					0.1105	
H1 - Number of Escape Routes		**0.0196**					
Required Number							
2	2		0.0392	0.0392	0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**					
Width							
Width < 1000 mm	0		0.000				
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Exitways	4		0.0204	0.0204	0.0204	0.0204	0.0204
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
20 < DEOP ≤ 25 m	4		0.0796				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					

Purpose Group			WL	B3	D3	J3	G1
Occupants			100	100	100	100	100
Range of TOP Length							
50 < TOP ≤ 60 m	4		0.0796				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
45 < PP ≤ 60 m	3		0.0816				
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	1			0.0454	0.0454		0.0454
Walls and Ceilings (or Ceilings Only)	3		0.1362			0.1362	
H10 - Signage		**0.0051**					
Extent							
Fire Exit Signs	1			0.0051	0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153				
Total Fire Safety Features (FSF)		**0.8116**	**1.853**	**1.283**	**1.283**	**1.492**	**1.222**
Fire Safety Index		**1.00**	**2.638**	**2.068**	**2.068**	**2.277**	**2.007**

Appendix AG – Fire Safety Index Calculations – PG: WL (≤ 4m, ≤ 500 occupants)

Purpose Group			WL	B3	D3	J3	G1
Occupants			500	500	500	500	500
Density			0.1	1/15	1/15	1/50	1/15
Area	m^2		5000	7500	7500	25000	7500
Alarm			6	4, SP	4, SP	4, SP	4, SP
Height	m		< 4	3 m	3 m	3 m	3 m
Storeys			2	Double	Double	Double	Double
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Working Purpose Groups							
Low Risk Commercial	5		0.166	0.166			
Low Risk Industrial	5				0.166		
Low Risk Storage	5					0.166	
Offices	5						0.166
	5						
BU2 - Building Escape Height		**0.0663**					
< 4m			0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
101 < Occ. No. ≤ 500	3		0.0663	0.0663	0.0663	0.0663	0.0663
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	0.1989

Purpose Group			WL	B3	D3	J3	G1
Occupants			500	500	500	500	500
Total Building Use Score (BUS)		**0.1879**	**0.7627**	**0.7627**	**0.7627**	**0.7627**	**0.7627**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
30	2		0.3008	0.3008	0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating		**0.0962**					
30	1			0.0962	0.0962		0.0962
60	2		0.1924			0.1924	
B - Fire Alarm Type		**0.1176**					
Alarm Type							
Type 2 Alarm - Manual Alarm	2		0.235				
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5			0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000				
Automatic Natural Ventilation	4			0.080	0.080	0.080	0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**					
Type							
Class C	2		0.038				
Class A	5			0.095	0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					

Purpose Group			WL	B3	D3	J3	G1
Occupants			500	500	500	500	500
Type							
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884		0.0884
Fire Hydrant System	5					0.1105	
H1 - Number of Escape Routes		**0.0196**					
Required Number							
2	2		0.0392				
3	3			0.0588	0.0588	0.0588	0.0588
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392				
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Exitways	4			0.0204	0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255				
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
45 < DEOP ≤ 60 m	1		0.0199				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
110 < TOP ≤ 140 m	1		0.0199				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
45 < PP ≤ 60 m	3		0.0816				
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI > 12	3			0.0336	0.0336	0.0336	0.0336
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448				
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	2		0.0908	0.0908	0.0908	0.0908	0.0908
H10 - Signage		**0.0051**					

Purpose Group			WL	B3	D3	J3	G1
Occupants			500	500	500	500	500
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Flashing Illuminated Exit Signs	5						
Total Fire Safety Features (FSF)		**0.8116**	**1.634**	**2.386**	**2.386**	**2.505**	**2.386**
Fire Safety Index		**1.00**	**2.396**	**3.149**	**3.149**	**3.267**	**3.149**

Appendix AH – Fire Safety Index Calculations – PG: WL (≤ 4m, ≤ 1000 occupants)

Purpose Group			WL	B3	D3	J3	G1
Occupants			1000	1000	1000	1000	1000
Density			0.1	1/15	1/15	1/50	1/15
Area	m^2		10000	15000	15000	50000	15000
Max. Occupants				667			667
Height	m		< 4	3 m	3 m	3 m	3 m
Alarm			7	4, SP	4, SP	4, SP	4, SP
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Working Purpose Groups							
Low Risk Commercial	5		0.166	0.166			
Low Risk Industrial	5				0.166		
Low Risk Storage	5					0.166	
Offices	5						0.166
BU2 - Building Escape Height		**0.0663**					
< 4m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
501 < Occ. No. ≤ 1000	2		0.0442	0.0442	0.0442	0.0442	0.0442
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7406**	**0.7406**	**0.7406**	**0.7406**	**0.7406**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
30	2		0.3008	0.3008	0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating		**0.0962**					
30	1			0.0962	0.0962		0.0962
60	2		0.1924			0.1924	
B - Fire Alarm Type		**0.1176**					
Alarm Type							
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**					
Smoke Control							

Purpose Group			WL	B3	D3	J3	G1
Occupants			1000	1000	1000	1000	1000
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000				
Automatic Natural Ventilation	4			0.080	0.080	0.080	0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**					
Type							
Class C	2		0.038				
Class A	5			0.095	0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1			0.0266	0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133				
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
No Hydrant System or Hose Run > 75m	0			0.000	0.000		0.000
Fire Hydrant System	5		0.1105			0.1105	
H1 - Number of Escape Routes		**0.0196**					
Required Number							
3	3		0.0588				
≥ 4	4			0.0784	0.0784	0.0784	0.0784
H2 - Width of Escape Routes		**0.0196**					
Width							

Purpose Group			WL	B3	D3	J3	G1
Occupants			1000	1000	1000	1000	1000
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392				
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Exitways	4			0.0204	0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255				
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
> 60 m	0		0.000				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
> 140 m	0		0.000				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
45 < PP ≤ 60 m	3		0.0816				
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI > 12	3			0.0336	0.0336	0.0336	0.0336
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448				
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	2		0.0908	0.0908	0.0908	0.0908	0.0908
H10 - Signage		**0.0051**					
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**2.095**	**2.317**	**2.317**	**2.524**	**2.317**
Fire Safety Index		**1.00**	**2.835**	**3.058**	**3.058**	**3.265**	**3.058**

Appendix AI – Fire Safety Index Calculations – PG: WL (≤ 4m, ≤ 1200 occupants)

Purpose Group			WL	B3	D3	J3	G1
Occupants			1200	1200	1200	1200	1200
Density			0.1	1/15	1/15	1/50	1/15
Area	m^2		12000	18000	18000	60000	18000
Max. Occupants				667			667
Height	m		< 4	3 m	3 m	3 m	3 m
Alarm			7	4, SP	4, SP	4, SP	4, SP

Purpose Group			WL	B3	D3	J3	G1
Occupants			1200	1200	1200	1200	1200
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Working Purpose Groups							
Low Risk Commercial	5		0.166	0.166			
Low Risk Industrial	5				0.166		
Low Risk Storage	5					0.166	
Offices	5						0.166
BU2 - Building Escape Height		**0.0663**					
< 4m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
>1000	1		0.0221		0.0221	0.0221	
501 < Occ. No. ≤ 1000	2			0.0442			0.0442
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7185**	**0.7406**	**0.7185**	**0.7185**	**0.7406**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
30	2		0.3008	0.3008	0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating		**0.0962**					
30	1			0.0962	0.0962		0.0962
60	2		0.1924			0.1924	
B - Fire Alarm Type		**0.1176**					
Alarm Type							
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000				
Automatic Natural Ventilation	4			0.080	0.080	0.080	0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**					
Type							
Class C	2		0.038				

Purpose Group			WL	B3	D3	J3	G1
Occupants			1200	1200	1200	1200	1200
Class A	5			0.095	0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1			0.0266	0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133				
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
No Hydrant System or Hose Run > 75m	0			0.000	0.000		0.000
Fire Hydrant System	5		0.1105			0.1105	
H1 - Number of Escape Routes		**0.0196**					
Required Number							
≥ 4	4		0.0784	0.0784	0.0784	0.0784	0.0784
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392				
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Exitways	4			0.0204	0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255				
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
> 60 m	0		0.000				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
> 140 m	0		0.000				

Purpose Group			WL	B3	D3	J3	G1
Occupants			1200	1200	1200	1200	1200
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
45 < PP ≤ 60 m	3		0.0816				
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI > 12	3			0.0336	0.0336	0.0336	0.0336
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448				
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	2		0.0908	0.0908	0.0908	0.0908	0.0908
H10 - Signage		**0.0051**					
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**2.114**	**2.317**	**2.317**	**2.524**	**2.317**
Fire Safety Index		**1.00**	**2.833**	**3.058**	**3.036**	**3.243**	**3.058**

Appendix AJ – Fire Safety Index Calculations – PG: WM (0m, ≤ 50 occupants)

Purpose Group			WM	B2	D2	J2
Occupants			50	50	50	50
Density			0.1	1/15	1/15	1/50
Area	m^2		500	750	750	2500
Height	m		0	0 m	0 m	0 m
Alarm			2af			
Storeys			1	Single	Single	Single
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Working Purpose Groups						
Moderate Risk Industrial	5			0.166		
Moderate Risk Commercial	5				0.166	
Moderate Risk Storage	5		0.166			0.166
Low Risk Commercial	5					
Low Risk Industrial	5					
Low Risk Storage	5					
Offices	5					
BU2 - Building Escape Height		**0.0663**				
>58m	0					
46m < H_e ≤ 58m	1					
34m < H_e ≤ 46m	2					
25m < H_e ≤ 34m	3					
10m < H_e ≤ 25m	4					
4m < H_e ≤ 10m	5					
< 4m	5					

Purpose Group			WM	B2	D2	J2
Occupants			50	50	50	50
0m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
>1000	1					
501 < Occ. No. ≤ 1000	2					
101 < Occ. No. ≤ 500	3					
51 < Occ. No. ≤ 100	4					
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**				
4	0					
3	1		0.0663	0.0663	0.0663	0.0663
2	3					
1	5					
Total Building Use Score (BUS)		**0.1879**	**0.6743**	**0.6743**	**0.6743**	**0.6743**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
0	0		0.000			
15	1					
30	2			0.3008	0.3008	0.3008
45	3					
60	4					
>60	5					
A2 - Structural Fire Endurance Rating		**0.0962**				
0	0					
30	1			0.0962	0.0962	
60	2		0.1924			0.1924
90	3					
120	4					
>120	5					
B - Fire Alarm Type		**0.1176**				
Alarm Type						
No Alarm	0		0.000	0.000	0.000	0.000
Type 2 Alarm - Manual Alarm	2					
Type 3 Alarm - Automatic Alarm with Heat Detectors	3					
Type 5 Alarm - Automatic Alarm with Heat and Local Smoke Detectors	4					
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5					
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000	0.000	0.000	0.000
Manual Shutdown	2					
Automatic Shutdown	5					
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Manual Natural Ventilation	1					

Purpose Group			WM	B2	D2	J2
Occupants			50	50	50	50
Manual Mechanical Extraction	2					
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
Automatic Mechanical Ventilation	5					
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
Yes	5					
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000	0.000	0.000	0.000
Dry Pipe Sprinkler System	4					
Wet Pipe Sprinkler System	5					
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000	0.000	0.000	0.000
Class C	2					
Class B	4					
Class A	5					
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Blanket	1					
Fire Extinguisher	3					
Fire Hose Reel	4					
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
Emergency Power Supply	5					
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
Voice Communication System	3					
Fire Systems Centre	4					
Voice Communication System & Fire Systems Centre	5					
G1 - Alerting		**0.0266**				
Type						
No means for alerting the Fire Service	0					
Telephone	1		0.0266	0.0266	0.0266	0.0266
Direct Connection via Security Firm	4					
Direct Connection to Fire Service	5					
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
Yes	5					
G3 - Fire Fighting Access		**0.0221**				

Purpose Group			WM	B2	D2	J2
Occupants			50	50	50	50
Type						
No Hydrant System or Hose Run > 75m	0					
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	
Fire Hydrant System	5					0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
1	1		0.0196			
2	2			0.0392	0.0392	0.0392
3	3					
≥ 4	4					
H2 - Width of Escape Routes		**0.0196**				
Width						
Width < 1000 mm	0		0.000			
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2					
4500 mm ≤ Width < 9000mm	3					
9000mm ≤ Width	5					
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
None	0			0.000	0.000	0.000
At Final Exit	2		0.0102			
Exitways	4					
Open Paths and Exitways	5					
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
In Staircase (< 6 persons capacity)	3					
Protected Lobby to Staircase (> 6 persons capacity)	5					
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
> 60 m	0					
45 < DEOP ≤ 60 m	1					
30 < DEOP ≤ 45 m	2					
25 < DEOP ≤ 30 m	3					
20 < DEOP ≤ 25 m	4		0.0796			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
> 140 m	0					
110 < TOP ≤ 140 m	1					
80 < TOP ≤ 110 m	2					
60 < TOP ≤ 80 m	3					
50 < TOP ≤ 60 m	4		0.0796			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
> 90 m	0					
75 < PP ≤ 90 m	1					
60 < PP ≤ 75 m	2					

Purpose Group			WM	B2	D2	J2
Occupants			50	50	50	50
45 < PP ≤ 60 m	3		0.0816			
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088
PP ≤ 30 m	5					
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI > 0, SDI > 3, FI > 12	0					
SFI = 0, SDI ≤ 3, FI > 12	3					
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
No applied surface finishes, non-combustible surfaces	5					
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Walls and Ceilings	0					
Ceilings	1					
Ceilings	2			0.0908	0.0908	
Walls and Ceilings (or Ceilings Only)	3		0.1362			
Walls and Ceilings	4					
Walls and Ceilings	5					0.227
H10 - Signage		**0.0051**				
Extent						
None	0					
Fire Exit Signs	1			0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153			
Flashing Illuminated Exit Signs	5					
Total Fire Safety Features (FSF)		**0.8116**	**0.794**	**1.124**	**1.124**	**1.378**
Fire Safety Index		**1.00**	**1.468**	**1.798**	**1.798**	**2.053**

Appendix AK – Fire Safety Index Calculations – PG: WM (0m, ≤ 100 occupants)

Purpose Group			WM	B2	D2	J2
Occupants			100	100	100	100
Density			0.1	1/15	1/15	1/50
Area	m^2		1000	1500	1500	5000
Height	m		0	0 m	0 m	0 m
Alarm			2af			SP
Storeys			1	Single	Single	Single
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Working Purpose Groups						
Moderate Risk Industrial	5			0.166		
Moderate Risk Commercial	5				0.166	
Moderate Risk Storage	5		0.166			0.166
BU2 - Building Escape Height		**0.0663**				
0m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
51 < Occ. No. ≤ 100	4		0.0884	0.0884	0.0884	0.0884

Purpose Group			WM	B2	D2	J2
Occupants			100	100	100	100
BU4 - Fire Hazard Category		**0.0663**				
3	1		0.0663	0.0663	0.0663	0.0663
Total Building Use Score (BUS)		**0.1879**	**0.6522**	**0.6522**	**0.6522**	**0.6522**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
0	0		0.000			
30	2			0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating		**0.0962**				
30	1			0.0962	0.0962	
60	2		0.1924			0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
No Alarm	0			0.000	0.000	0.000
Type 2 Alarm - Manual Alarm	2		0.235			
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000	0.000	0.000	0.000
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000	0.000	0.000	
Wet Pipe Sprinkler System	5					0.3565
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000	0.000	0.000	
Class A	5					0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						

Purpose Group			WM	B2	D2	J2
Occupants			100	100	100	100
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hose Run < 75m	4		0.0884			
Fire Hydrant System	5			0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
2	2		0.0392	0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**				
Width						
Width < 1000 mm	0		0.000			
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
None	0			0.000	0.000	0.000
Open Paths and Exitways	5		0.0255			
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
20 < DEOP ≤ 25 m	4		0.0796			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
50 < TOP ≤ 60 m	4		0.0796			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
45 < PP ≤ 60 m	3		0.0816			
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	2			0.0908	0.0908	0.0908

Purpose Group			WM	B2	D2	J2
Occupants			100	100	100	100
Walls and Ceilings (or Ceilings Only)	3		0.1362			
H10 - Signage		**0.0051**				
Extent						
Fire Exit Signs	1			0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153			
Total Fire Safety Features (FSF)		**0.8116**	**1.064**	**1.146**	**1.146**	**1.694**
Fire Safety Index		**1.00**	**1.716**	**1.798**	**1.798**	**2.346**

Appendix AL – Fire Safety Index Calculations – PG: WM (0m, ≤ 500 occupants)

Purpose Group			WM	B2	D2	J2
Occupants			500	500	500	500
Density			0.1	1/15	1/15	1/50
Area	m^2		5000	7500	7500	25000
Height	m		0	Single		
Alarm			3f	SP	SP	SP
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Working Purpose Groups						
Moderate Risk Industrial	5			0.166		
Moderate Risk Commercial	5				0.166	
Moderate Risk Storage	5		0.166			0.166
BU2 - Building Escape Height		**0.0663**				
0m	5		0.332	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
101 < Occ. No. ≤ 500	3		0.066	0.0663	0.0663	0.0663
BU4 - Fire Hazard Category		**0.0663**				
3	1		0.066	0.0663	0.0663	0.0663
Total Building Use Score (BUS)		**0.1879**	**0.63**	**0.6301**	**0.6301**	**0.6301**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
0	0		0.000			
30	2			0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating		**0.0962**				
30	1			0.0962	0.0962	
60	2		0.192			0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
No Alarm	0			0.000	0.000	0.000
Type 3 Alarm - Automatic Alarm with Heat Detectors	3		0.353			

Purpose Group			WM	B2	D2	J2
Occupants			500	500	500	500
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000	0.000	0.000	0.000
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000			
Wet Pipe Sprinkler System	5			0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000			
Class A	5			0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.02			
G1 - Alerting		**0.0266**				
Type						
Telephone	1		0.027	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hydrant System	5		0.111	0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
2	2		0.039			
3	3			0.0588	0.0588	0.0588
H2 - Width of Escape Routes		**0.0196**				

Purpose Group			WM	B2	D2	J2
Occupants			500	500	500	500
Width						
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Exitways	4			0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.026			
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
25 < DEOP ≤ 30 m	3		0.06			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
60 < TOP ≤ 80 m	3		0.06			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
45 < PP ≤ 60 m	3		0.082			
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088
PP ≤ 30 m	5					
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.045	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	1			0.0454	0.0454	
Ceilings	2					0.0908
Walls and Ceilings (or Ceilings Only)	3		0.136			
H10 - Signage		**0.0051**				
Extent						
Illuminated Fire Exit Signs	3		0.015	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.183**	**1.602**	**1.602**	**1.744**
Fire Safety Index		**1.00**	**1.814**	**2.232**	**2.232**	**2.374**

Appendix AM – Fire Safety Index Calculations – PG: WM (0m, ≤ 1000 occupants)

Purpose Group			WM	B2	D2	J2
Occupants			1000	1000	1000	1000
Density			0.1	1/15	1/15	1/50
Area	m^2		10000	15000	15000	50000
Height	m		0			

Purpose Group			WM	B2	D2	J2
Occupants			1000	1000	1000	1000
Alarm			4	4, SP	4, SP	4, SP
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Working Purpose Groups						
Moderate Risk Industrial	5			0.166		
Moderate Risk Commercial	5				0.166	
Moderate Risk Storage	5		0.166			0.166
BU2 - Building Escape Height		**0.0663**				
0m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
501 < Occ. No. ≤ 1000	2		0.0442	0.0442	0.0442	0.0442
BU4 - Fire Hazard Category		**0.0663**				
3	1		0.0663	0.0663	0.0663	0.0663
Total Building Use Score (BUS)		**0.1879**	**0.608**	**0.608**	**0.608**	**0.608**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
0	0		0.000			
30	2			0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating		**0.0962**				
30	1			0.0962	0.0962	
60	2		0.1924			0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000			
Wet Pipe Sprinkler System	5			0.3565	0.3565	0.357
D2 - Water Supply		**0.0190**				
Type						

Purpose Group			WM	B2	D2	J2
Occupants			1000	1000	1000	1000
None	0		0.000			
Class A	5			0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hydrant System	5		0.1105	0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
3	3		0.0588			
≥ 4	4			0.0784	0.0784	0.0784
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392			
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Exitways	4			0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255			
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
45 < DEOP ≤ 60 m	1		0.0199			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
110 < TOP ≤ 140 m	1		0.0199			

Purpose Group			WM	B2	D2	J2
Occupants			1000	1000	1000	1000
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
45 < PP ≤ 60 m	3		0.0816			
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	1			0.0454	0.0454	
Ceilings	2					0.0908
Walls and Ceilings (or Ceilings Only)	3		0.1362			
H10 - Signage		**0.0051**				
Extent						
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.378**	**2.394**	**2.394**	**2.535**
Fire Safety Index		**1.00**	**1.986**	**3.002**	**3.002**	**3.143**

Appendix AN – Fire Safety Index Calculations – PG: WM (0m, ≤ 1200 occupants)

Purpose Group			WM	B2	D2	J2
Occupants			1200	1200	1200	1200
Density			0.1	1/15	1/15	1/50
Area	m^2		12000	18000	18000	60000
Alarm			7	4, SP	4, SP	4, SP
Height			0	0 m	0 m	0 m
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Working Purpose Groups						
Moderate Risk Industrial	5			0.166		
Moderate Risk Commercial	5				0.166	
Moderate Risk Storage	5		0.166			0.166
BU2 - Building Escape Height		**0.0663**				
0m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
>1000	1		0.0221	0.0221	0.0221	0.0221
BU4 - Fire Hazard Category		**0.0663**				
3	1		0.0663	0.0663	0.0663	0.0663
Total Building Use Score (BUS)		**0.1879**	**0.5859**	**0.5859**	**0.5859**	**0.5859**
Fire Safety Features						

Purpose Group			WM	B2	D2	J2
Occupants			1200	1200	1200	1200
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
0	0		0.000			
30	2			0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating		**0.0962**				
30	1			0.0962	0.0962	
60	2		0.1924			0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
Automatic Mechanical Ventilation	5					
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**				
Type						
Class C	2		0.038			
Class A	5			0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
No means for alerting the Fire Service	0					
Telephone	1			0.0266	0.0266	0.0266

Purpose Group			WM	B2	D2	J2
Occupants			1200	1200	1200	1200
Direct Connection to Fire Service	5		0.133			
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hydrant System	5		0.1105	0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
≥ 4	4		0.0784	0.0784	0.0784	0.0784
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392			
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Exitways	4			0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255			
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
> 60 m	0		0.000			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
> 140 m	0		0.000			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
45 < PP ≤ 60 m	3		0.0816			
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088
PP ≤ 30 m	5					
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
No applied surface finishes, non-combustible surfaces	5					
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	1		0.0454	0.0454	0.0454	
Ceilings	2					0.0908
Walls and Ceilings	5					
H10 - Signage		**0.0051**				

Purpose Group			WM	B2	D2	J2
Occupants			1200	1200	1200	1200
Extent						
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153
Flashing Illuminated Exit Signs	5					
Total Fire Safety Features (FSF)		**0.8116**	**1.768**	**2.394**	**2.394**	**2.535**
Fire Safety Index		**1.00**	**2.354**	**2.980**	**2.980**	**3.121**

Appendix AO – Fire Safety Index Calculations – PG: WM (≤ 4m, ≤ 50 occupants)

Purpose Group			WM	B2	D2	J2
Occupants			50	50	50	50
Density			0.1	1/15	1/15	1/50
Area	m^2		500	750	750	2500
Height	m		< 4	3 m	3 m	3 m
Alarm			2af			
Storeys			2	Double	Double	Double
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Working Purpose Groups						
Moderate Risk Industrial	5			0.166		
Moderate Risk Commercial	5				0.166	
Moderate Risk Storage	5		0.166			0.166
BU2 - Building Escape Height		**0.0663**				
< 4m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**				
3	1		0.0663	0.0663	0.0663	0.0663
Total Building Use Score (BUS)		**0.1879**	**0.6743**	**0.6743**	**0.6743**	**0.6743**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
60	4		0.6016	0.6016	0.6016	0.6016
A2 - Structural Fire Endurance Rating		**0.0962**				
30	1			0.0962	0.0962	
60	2					0.1924
120	4		0.3848			
B - Fire Alarm Type		**0.1176**				
Alarm Type						
No Alarm	0		0.000	0.000	0.000	0.000
C1 - HVAC Control		**0.0368**				
Smoke Control						

Purpose Group			WM	B2	D2	J2
Occupants			50	50	50	50
None	0		0.000			0.000
Automatic Shutdown	5			0.184	0.184	
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000	0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
No means for alerting the Fire Service	0					
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hose Run < 75m	4		0.0884			
Fire Hydrant System	5			0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
1	1		0.0196			
2	2			0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**				
Width						
Width < 1000 mm	0		0.000			

Purpose Group			WM	B2	D2	J2
Occupants			50	50	50	50
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
None	0			0.000	0.000	0.000
Exitways	4		0.0204			
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
20 < DEOP ≤ 25 m	4		0.0796			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
50 < TOP ≤ 60 m	4		0.0796			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
60 < PP ≤ 75 m	2					
45 < PP ≤ 60 m	3		0.0816			
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	2			0.0908	0.0908	
Walls and Ceilings (or Ceilings Only)	3		0.1362			
Walls and Ceilings	5					0.227
H10 - Signage		**0.0051**				
Extent						
Fire Exit Signs	1			0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153			
Flashing Illuminated Exit Signs	5					
Total Fire Safety Features (FSF)		**0.8116**	**1.598**	**1.631**	**1.631**	**1.679**
Fire Safety Index		**1.00**	**2.272**	**2.305**	**2.305**	**2.353**

Appendix AP – Fire Safety Index Calculations – PG: WM (≤ 4m, ≤ 100 occupants)

Purpose Group			WM	B2	D2	J2
Occupants			100	100	100	100
Density			0.1	1/15	1/15	1/50
Area	m^2		1000	1500	1500	5000

Purpose Group			WM	B2	D2	J2
Occupants			100	100	100	100
Height	m		< 4	3 m	3 m	3 m
Alarm			2af			SP
Storeys			2	Double	Double	Double
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Working Purpose Groups						
Moderate Risk Industrial	5			0.166		
Moderate Risk Commercial	5				0.166	
Moderate Risk Storage	5		0.166			0.166
BU2 - Building Escape Height		**0.0663**				
< 4m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
51 < Occ. No. ≤ 100	4		0.0884	0.0884	0.0884	0.0884
BU4 - Fire Hazard Category		**0.0663**				
3	1		0.0663	0.0663	0.0663	0.0663
Total Building Use Score (BUS)		**0.1879**	**0.6522**	**0.6522**	**0.6522**	**0.6522**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
60	4		0.6016	0.6016	0.6016	0.6016
A2 - Structural Fire Endurance Rating		**0.0962**				
0	0					
30	1			0.0962	0.0962	
60	2					0.1924
120	4		0.3848			
B - Fire Alarm Type		**0.1176**				
Alarm Type						
No Alarm	0			0.000	0.000	0.000
Type 2 Alarm - Manual Alarm	2		0.235			
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			0.000
Automatic Shutdown	5			0.184	0.184	
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000	0.000	0.000	

Purpose Group			WM	B2	D2	J2
Occupants			100	100	100	100
Wet Pipe Sprinkler System	5					0.3565
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000	0.000	0.000	
Class A	5					0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
No means for alerting the Fire Service	0					
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hose Run < 75m	4		0.0884			
Fire Hydrant System	5			0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
2	2		0.0392	0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**				
Width						
Width < 1000 mm	0		0.000			
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Exitways	4			0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255			
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
20 < DEOP ≤ 25 m	4		0.0796			

Purpose Group			WM	B2	D2	J2
Occupants			100	100	100	100
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
50 < TOP ≤ 60 m	4		0.0796			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
45 < PP ≤ 60 m	3		0.0816			
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	2			0.0908	0.0908	0.0908
Walls and Ceilings (or Ceilings Only)	3		0.1362			
H10 - Signage		**0.0051**				
Extent						
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153
Flashing Illuminated Exit Signs	5					
Total Fire Safety Features (FSF)		**0.8116**	**1.858**	**1.661**	**1.661**	**2.025**
Fire Safety Index		**1.00**	**2.510**	**2.313**	**2.313**	**2.677**

Appendix AQ – Fire Safety Index Calculations – PG: WM (≤ 4m, ≤ 500 occupants)

Purpose Group			WM	B2	D2	J2
Occupants			500	500	500	500
Density			0.1	1/15	1/15	1/50
Area	m^2		5000	7500	7500	25000
Height	m		< 4	Double	5000	5000
Max. Occupants					333	100
Alarm			3f	SP	SP	SP
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Working Purpose Groups						
Moderate Risk Industrial	5			0.166		
Moderate Risk Commercial	5				0.166	
Moderate Risk Storage	5		0.166			0.166
BU2 - Building Escape Height		**0.0663**				
< 4m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
101 < Occ. No. ≤ 500	3		0.0663	0.0663	0.0663	
51 < Occ. No. ≤ 100	4					0.0884

Purpose Group			WM	B2	D2	J2
Occupants			500	500	500	500
BU4 - Fire Hazard Category		**0.0663**				
3	1		0.0663	0.0663	0.0663	0.0663
Total Building Use Score (BUS)		**0.1879**	**0.6301**	**0.6301**	**0.6301**	**0.6522**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
60	4		0.6016	0.6016	0.6016	0.6016
A2 - Structural Fire Endurance Rating		**0.0962**				
30	1			0.0962	0.0962	
60	2					0.1924
120	4		0.3848			
B - Fire Alarm Type		**0.1176**				
Alarm Type						
No Alarm	0			0.000	0.000	0.000
Type 3 Alarm - Automatic Alarm with Heat Detectors	3		0.3528			
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			0.000
Automatic Shutdown	5			0.184	0.184	
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000			
Wet Pipe Sprinkler System	5			0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000			
Class A	5			0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				

Purpose Group			WM	B2	D2	J2
Occupants			500	500	500	500
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
No means for alerting the Fire Service	0					
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hydrant System	5		0.1105	0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
2	2		0.0392			
3	3			0.0588	0.0588	0.0588
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Exitways	4			0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255			
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
25 < DEOP ≤ 30 m	3		0.0597			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
60 < TOP ≤ 80 m	3		0.0597			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
45 < PP ≤ 60 m	3		0.0816			
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						

Purpose Group			WM	B2	D2	J2
Occupants			500	500	500	500
Ceilings	1			0.0454	0.0454	
Ceilings	2					0.0908
Walls and Ceilings (or Ceilings Only)	3		0.1362			
H10 - Signage		**0.0051**				
Extent						
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.977**	**2.087**	**2.087**	**2.045**
Fire Safety Index		**1.00**	**2.608**	**2.717**	**2.717**	**2.697**

Appendix AR – Fire Safety Index Calculations – PG: WM (≤ 4m, ≤ 1000 occupants)

Purpose Group			WM	B2	D2	J2
Occupants			1000	1000	1000	1000
Density			0.1	1/15	1/15	1/50
Area	m^2		10000	15000	15000	50000
Height	m		< 4	10000	5000	5000
Max. Occupants				667	333	100
Alarm			4	4, SP	4, SP	4, SP
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Working Purpose Groups						
Moderate Risk Industrial	5			0.166		
Moderate Risk Commercial	5				0.166	
Moderate Risk Storage	5		0.166			0.166
BU2 - Building Escape Height		**0.0663**				
< 4m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
501 < Occ. No. ≤ 1000	2		0.0442	0.0442		
101 < Occ. No. ≤ 500	3				0.0663	
51 < Occ. No. ≤ 100	4					0.0884
BU4 - Fire Hazard Category		**0.0663**				
3	1		0.0663	0.0663	0.0663	0.0663
Total Building Use Score (BUS)		**0.1879**	**0.608**	**0.608**	**0.6301**	**0.6522**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
60	4		0.6016	0.6016	0.6016	0.6016
A2 - Structural Fire Endurance Rating		**0.0962**				
0	0					
30	1			0.0962	0.0962	
60	2					0.1924
120	4		0.3848			

Purpose Group			WM	B2	D2	J2
Occupants			1000	1000	1000	1000
B - Fire Alarm Type		**0.1176**				
Alarm Type						
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000			
Wet Pipe Sprinkler System	5			0.3565	0.3565	0.357
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000			
Class A	5			0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hydrant System	5		0.1105	0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				

Purpose Group			WM	B2	D2	J2
Occupants			1000	1000	1000	1000
Required Number						
3	3		0.0588			
≥ 4	4			0.0784	0.0784	0.0784
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392			
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Exitways	4			0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255			
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
45 < DEOP ≤ 60 m	1		0.0199			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
110 < TOP ≤ 140 m	1		0.0199			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
45 < PP ≤ 60 m	3		0.0816			
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	1			0.0454	0.0454	
Ceilings	2					0.0908
Walls and Ceilings (or Ceilings Only)	3		0.1362			
H10 - Signage		**0.0051**				
Extent						
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153
Flashing Illuminated Exit Signs	5					
Total Fire Safety Features (FSF)		**0.8116**	**2.172**	**2.695**	**2.695**	**2.836**
Fire Safety Index		**1.00**	**2.780**	**3.303**	**3.325**	**3.488**

Appendix AS – Fire Safety Index Calculations – PG: WM (≤ 4m, ≤ 1200 occupants)

Purpose Group			WM	B2	D2	J2
Occupants			1200	1200	1200	1200
Density			0.1	1/15	1/15	1/50
Area	m^2		12000	18000	18000	60000
Height	m		< 4	10000	5000	5000
Max. Occupants				667	333	100
Alarm			7	4, SP	4, SP	4, SP
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Working Purpose Groups						
Moderate Risk Industrial	5			0.166		
Moderate Risk Commercial	5				0.166	
Moderate Risk Storage	5		0.166			0.166
BU2 - Building Escape Height		**0.0663**				
< 4m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
>1000	1		0.0221			
501 < Occ. No. ≤ 1000	2			0.0442		
101 < Occ. No. ≤ 500	3				0.0663	
51 < Occ. No. ≤ 100	4					0.0884
BU4 - Fire Hazard Category		**0.0663**				
3	1		0.0663	0.0663	0.0663	0.0663
Total Building Use Score (BUS)		**0.1879**	**0.5859**	**0.608**	**0.6301**	**0.6522**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
30	2		0.3008			
60	4			0.6016	0.6016	0.6016
>60	5					
A2 - Structural Fire Endurance Rating		**0.0962**				
30	1			0.0962	0.0962	
60	2		0.1924			0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
C3 - Stairwell Pressurisation		**0.0201**				

Purpose Group			WM	B2	D2	J2
Occupants			1200	1200	1200	1200
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**				
Type						
Class C	2		0.038			
Class A	5			0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1			0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133			
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hydrant System	5		0.1105	0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
≥ 4	4		0.0784	0.0784	0.0784	0.0784
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392			
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Exitways	4			0.0204	0.0204	0.0204
Open Paths and Exitways	5		0.0255			
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000

Purpose Group			WM	B2	D2	J2
Occupants			1200	1200	1200	1200
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
> 60 m	0		0.000			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
> 140 m	0		0.000			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
45 < PP ≤ 60 m	3		0.0816			
30 < PP ≤ 45 m	4			0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	1		0.0454	0.0454	0.0454	
Ceilings	2					0.0908
H10 - Signage		**0.0051**				
Extent						
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**2.069**	**2.695**	**2.695**	**2.836**
Fire Safety Index		**1.00**	**2.655**	**3.303**	**3.325**	**3.488**

Appendix AT – Fire Safety Index Calculations – PG: CS (0m, ≤ 50 occupants)

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			50	50	50	50	50
Density			1	1	1/5	1	1/20
Area	m^2		50	50	250	50	1000
Height	m		0	0 m	0 m	0 m	0 m
Alarm			2	2			2
Storeys			1	Single	Single	Single	Single
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Crowd Purpose Groups							
Entertainment & Public Assembly	3		0.0996	0.0996			
Theatrical & Indoor Sport	3						
Places of Instruction	3				0.0996		
Worship	3					0.0996	
Exhibition Hall	3						
Museum	3						0.0996
BU2 - Building Escape Height		**0.0663**					

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			50	50	50	50	50
>58m	0						
46m < H_e ≤ 58m	1						
34m < H_e ≤ 46m	2						
25m < H_e ≤ 34m	3						
10m < H_e ≤ 25m	4						
4m < H_e ≤ 10m	5						
< 4m							
0m			0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
>1000	1						
501 < Occ. No. ≤ 1000	2						
101 < Occ. No. ≤ 500	3						
51 < Occ. No. ≤ 100	4						
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**					
4	0						
3	1						
2	3		0.1989	0.1989	0.1989	0.1989	
1	5						0.3315
Total Building Use Score (BUS)		**0.1879**	**0.7405**	**0.7405**	**0.7405**	**0.7405**	**0.8731**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
0	0		0.000				
15	1						
30	2			0.3008	0.3008	0.3008	0.3008
45	3						
60	4						
>60	5						
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**					
0	0						
30	1			0.0962	0.0962	0.0962	0.0962
60	2		0.1924				
90	3						
120	4						
>120	5						
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0		0.000		0.000	0.000	
Type 2 Alarm - Manual Alarm	2			0.235			0.235
Type 3 Alarm - Automatic Alarm with Heat Detectors	3						
Type 5 Alarm - Automatic Alarm with Heat and Local Smoke Detectors	4						
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5						
C1 - HVAC Control		**0.0368**					
Smoke Control							

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			50	50	50	50	50
None	0		0.000	0.000	0.000	0.000	0.000
Manual Shutdown	2						
Automatic Shutdown	5						
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000	0.000	0.000	0.000	0.000
Manual Natural Ventilation	1						
Manual Mechanical Extraction	2						
Automatic Natural Ventilation	4						
Automatic Mechanical Ventilation	5						
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
Yes	5						
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
Dry Pipe Sprinkler System	4						
Wet Pipe Sprinkler System	5						
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
Class C	2						
Class B	4						
Class A	5						
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Blanket	1						
Fire Extinguisher	3			0.0144	0.0144	0.0144	
Fire Hose Reel	4						
Fire Hose Reel and Extinguisher	5						0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
Emergency Power Supply	5						
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
Voice Communication System	3						
Fire Systems Centre	4						
Voice Communication System & Fire Systems Centre	5						
G1 - Alerting		**0.0266**					
Type							
No means for alerting the Fire Service	0						
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
Direct Connection via Security Firm	4						

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			50	50	50	50	50
Direct Connection to Fire Service	5						
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
Yes	5						
G3 - Fire Fighting Access		**0.0221**					
Type							
No Hydrant System or Hose Run > 75m	0						
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884	
Fire Hydrant System	5						0.1105
H1 - Number of Escape Routes		**0.0196**					
Required Number							
1	1		0.0196				
2	2			0.0392	0.0392	0.0392	0.0392
3	3						
≥ 4	4						
H2 - Width of Escape Routes		**0.0196**					
Width							
Width < 1000 mm	0		0.000				
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2						
4500 mm ≤ Width < 9000mm	3						
9000mm ≤ Width	5						
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
None	0						
At Final Exit	2		0.0102	0.0102	0.0102	0.0102	0.0102
Exitways	4						
Open Paths and Exitways	5						
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
In Staircase (< 6 persons capacity)	3						
Protected Lobby to Staircase (> 6 persons capacity)	5						
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
> 60 m	0						
45 < DEOP ≤ 60 m	1						
30 < DEOP ≤ 45 m	2						
25 < DEOP ≤ 30 m	3						
20 < DEOP ≤ 25 m	4						
≤ 20 m	5		0.0995	0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
> 140 m	0						
110 < TOP ≤ 140 m	1						
80 < TOP ≤ 110 m	2						
60 < TOP ≤ 80 m	3						

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			50	50	50	50	50
50 < TOP ≤ 60 m	4						
≤ 50 m	5		0.0995	0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
> 90 m	0						
75 < PP ≤ 90 m	1						
60 < PP ≤ 75 m	2						
45 < PP ≤ 60 m	3						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088	0.1088
PP ≤ 30 m	5						
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI > 0, SDI > 3, FI > 12	0						
SFI = 0, SDI ≤ 3, FI > 12	3						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
No applied surface finishes, non-combustible surfaces	5						
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Walls and Ceilings	0						
Ceilings	1					0.0454	
Ceilings	2			0.0908	0.0908		0.0908
Walls and Ceilings (or Ceilings Only)	3						
Walls and Ceilings	4		0.1816				
Walls and Ceilings	5						
H10 - Signage		**0.0051**					
Extent							
None	0						
Fire Exit Signs	1				0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153	0.0153			
Flashing Illuminated Exit Signs	5						
Total Fire Safety Features (FSF)		**0.8116**	**0.906**	**1.289**	**1.044**	**0.999**	**1.311**
Fire Safety Index		**1.00**	**1.647**	**2.030**	**1.784**	**1.739**	**2.184**

Appendix AU – Fire Safety Index Calculations – PG: CS (0m, ≤ 100 occupants)

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			100	100	100	100	100
Density			1	1	1/5	1	1/20
Area	m^2		100	100	500	100	2000
Height	m		0	0 m	0 m	0 m	0 m
Alarm			2	2			2
Storeys			1	Single	Single	Single	Single
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Crowd Purpose Groups							
Entertainment & Public Assembly	3		0.0996	0.0996			
Theatrical & Indoor Sport	3						

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			100	100	100	100	100
Places of Instruction	3				0.0996		
Worship	3					0.0996	
Exhibition Hall	3						
Museum	3						0.0996
BU2 - Building Escape Height		**0.0663**					
0m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
51 < Occ. No. ≤ 100	4		0.0884	0.0884	0.0884	0.0884	0.0884
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	
1	5						0.3315
Total Building Use Score (BUS)		**0.1879**	**0.7184**	**0.7184**	**0.7184**	**0.7184**	**0.851**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
0	0		0.000				
30	2			0.3008	0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**					
30	1			0.0962	0.0962	0.0962	0.0962
60	2		0.1924				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0				0.000	0.000	
Type 2 Alarm - Manual Alarm	2		0.235	0.235			0.235
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000	0.000	0.000	0.000	
Manual Natural Ventilation	1						0.020
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			100	100	100	100	100
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Extinguisher	3			0.0144	0.0144	0.0144	
Fire Hose Reel and Extinguisher	5						0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884	
Fire Hydrant System	5						0.1105
H1 - Number of Escape Routes		**0.0196**					
Required Number							
2	2		0.0392	0.0392	0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**					
Width							
Width < 1000 mm	0		0.000				
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
At Final Exit	2		0.0102	0.0102	0.0102	0.0102	
Open Paths and Exitways	5						0.0255
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
20 < DEOP ≤ 25 m	4		0.0796				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
≤ 50 m	5		0.0995	0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			100	100	100	100	100
Range of PP Length							
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	1					0.0454	
Ceilings	2			0.0908	0.0908		0.0908
Walls and Ceilings	4		0.1816				
Walls and Ceilings	5						
H10 - Signage		**0.0051**					
Extent							
Fire Exit Signs	1				0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153	0.0153			
Flashing Illuminated Exit Signs	5						
Total Fire Safety Features (FSF)		**0.8116**	**1.141**	**1.473**	**1.228**	**1.183**	**1.530**
Fire Safety Index		**1.00**	**1.860**	**2.192**	**1.946**	**1.901**	**2.381**

Appendix AV – Fire Safety Index Calculations – PG: CL (0m, ≤ 500 occupants)

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			500	500	500	500	500
Density			1	1	1/5	1	1/20
Area	m^2		500	500	2500	500	10000
Height	m		0	0 m	0 m	0 m	0 m
Alarm			3	2			2, SP
Storeys			1	Single	Single	Single	Single
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Crowd Purpose Groups							
Entertainment & Public Assembly	3		0.0996	0.0996			
Theatrical & Indoor Sport	3						
Places of Instruction	3				0.0996		
Worship	3					0.0996	
Museum	3						0.0996
BU2 - Building Escape Height		**0.0663**					
0m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
101 < Occ. No. ≤ 500	3		0.0663	0.0663	0.0663	0.0663	0.0663
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	
1	5						0.3315
Total Building Use Score (BUS)		**0.1879**	**0.6963**	**0.6963**	**0.6963**	**0.6963**	**0.8289**

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			500	500	500	500	500
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
0	0		0.000				
30	2			0.3008	0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**					
30	1			0.0962	0.0962	0.0962	0.0962
60	2		0.1924				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0				0.000	0.000	
Type 2 Alarm - Manual Alarm	2			0.235			0.235
Type 3 Alarm - Automatic Alarm with Heat Detectors	3		0.3528				
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000	0.000	0.000	0.000	
Automatic Natural Ventilation	4						0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	
Wet Pipe Sprinkler System	5						0.357
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	
Class A	5						0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			500	500	500	500	500
G1 - Alerting		**0.0266**					
Type							
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884	
Fire Hydrant System	5						0.1105
H1 - Number of Escape Routes		**0.0196**					
Required Number							
2	2		0.0392				
3	3			0.0588	0.0588	0.0588	0.0588
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
At Final Exit	2		0.0102				
Open Paths and Exitways	5			0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
20 < DEOP ≤ 25 m	4		0.0796				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
50 < TOP ≤ 60 m	4		0.0796				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	2			0.0908	0.0908		
Walls and Ceilings	4		0.1816				
H10 - Signage		**0.0051**					

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			500	500	500	500	500
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.258**	**1.518**	**1.283**	**1.237**	**2.026**
Fire Safety Index		**1.00**	**1.955**	**2.214**	**1.979**	**1.934**	**2.855**

Appendix AW – Fire Safety Index Calculations – PG: CL (0m, ≤ 1000 occupants)

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1000	1000	1000	1000	1000
Density			1	1	1/5	1	1/20
Area	m^2		1000	1000	5000	1000	20000
Alarm			4	2			2, SP
Height	m		0	0 m	0 m	0 m	0 m
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Crowd Purpose Groups							
Entertainment & Public Assembly	3		0.0996	0.0996			
Theatrical & Indoor Sport	3						
Places of Instruction	3				0.0996		
Worship	3					0.0996	
Exhibition Hall	3						
Museum	3						0.0996
BU2 - Building Escape Height		**0.0663**					
0m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
501 < Occ. No. ≤ 1000	2		0.0442	0.0442	0.0442	0.0442	0.0442
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	
1	5						0.3315
Total Building Use Score (BUS)		**0.1879**	**0.6742**	**0.6742**	**0.6742**	**0.6742**	**0.8068**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
0	0		0.000				
30	2			0.3008	0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**					
30	1			0.0962	0.0962	0.0962	0.0962
60	2		0.1924				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0				0.000	0.000	
Type 2 Alarm - Manual Alarm	2			0.235			0.235

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1000	1000	1000	1000	1000
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588				
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000	0.000	0.000	0.000	
Automatic Natural Ventilation	4						0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	
Wet Pipe Sprinkler System	5						0.3565
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	
Class A	5						0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1			0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884	
Fire Hydrant System	5						0.1105
H1 - Number of Escape Routes		**0.0196**					
Required Number							
3	3		0.0588	0.0588	0.0588	0.0588	0.0588

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1000	1000	1000	1000	1000
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.039				
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
30 < DEOP ≤ 45 m	2		0.0398				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
110 < TOP ≤ 140 m	1						
80 < TOP ≤ 110 m	2		0.0398				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	1					0.0454	0.0454
Ceilings	2			0.0908	0.0908		
Walls and Ceilings	4		0.1816				
H10 - Signage		**0.0051**					
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.575**	**1.518**	**1.283**	**1.237**	**2.026**
Fire Safety Index		**1.00**	**2.249**	**2.192**	**1.957**	**1.911**	**2.833**

Appendix AX – Fire Safety Index Calculations – PG: CL (0m, ≤ 1200 occupants)

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1200	1200	1200	1200	1200
Density			1	1	1/5	1	1/20
Area	m^2		1200	1200	6000	1200	24000

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1200	1200	1200	1200	1200
Alarm			7	2	SP		2, SP
Height	m		0	0 m	0 m	0 m	0 m
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Crowd Purpose Groups							
Entertainment & Public Assembly	3		0.0996	0.0996			
Theatrical & Indoor Sport	3						
Places of Instruction	3				0.0996		
Worship	3					0.0996	
Museum	3						0.0996
BU2 - Building Escape Height		**0.0663**					
0m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
>1000	1		0.0221	0.0221	0.0221	0.0221	0.0221
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	
1	5						0.3315
Total Building Use Score (BUS)		**0.1879**	**0.6521**	**0.6521**	**0.6521**	**0.6521**	**0.7847**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
0	0		0.000				
30	2			0.3008	0.3008	0.3008	0.3008
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**					
0	0						
30	1			0.0962	0.0962	0.0962	0.0962
60	2		0.1924				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0				0.000	0.000	
Type 2 Alarm - Manual Alarm	2			0.235			0.235
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588				
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000	0.000	0.000	0.000	
Automatic Natural Ventilation	4						0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1200	1200	1200	1200	1200
D1 - Sprinkler System		**0.0713**					
Type							
None	0			0.000	0.000	0.000	
Wet Pipe Sprinkler System	5		0.3565				0.3565
D2 - Water Supply		**0.0190**					
Type							
None	0			0.000	0.000	0.000	
Class C	2		0.038				
Class A	5						0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1			0.0266	0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133				
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884	
Fire Hydrant System	5						0.1105
H1 - Number of Escape Routes		**0.0196**					
Required Number							
3	3			0.0588	0.0588	0.0588	0.0588
≥ 4	4		0.0784				
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.039				
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1200	1200	1200	1200	1200
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
45 < DEOP ≤ 60 m	1		0.020				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
110 < TOP ≤ 140 m	1		0.020				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	1					0.0454	0.0454
Ceilings	2		0.0908	0.0908	0.0908		
H10 - Signage		**0.0051**					
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.858**	**1.518**	**1.283**	**1.237**	**2.026**
Fire Safety Index		**1.00**	**2.511**	**2.170**	**1.935**	**1.889**	**2.811**

Appendix AY – Fire Safety Index Calculations – PG: CL (≤ 4m, ≤ 50 occupants)

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			50	50	50	50	50
Density			1	1	1/5	1	1/20
Area	m^2		50	50	250	50	1000
Height	m		< 4	3 m	3 m	3 m	3 m
Alarm			2	2			2
Storeys			2	Double	Double	Double	Double
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Crowd Purpose Groups							
Entertainment & Public Assembly	3		0.0996	0.0996			
Theatrical & Indoor Sport	3						
Places of Instruction	3				0.0996		
Worship	3					0.0996	
Museum	3						0.0996
BU2 - Building Escape Height		**0.0663**					
< 4m	5		0.3315	0.3315	0.3315	0.3315	0.3315

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			50	50	50	50	50
BU3 - Occupant Numbers		**0.0221**					
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	
1	5						0.3315
Total Building Use Score (BUS)		**0.1879**	**0.7405**	**0.7405**	**0.7405**	**0.7405**	**0.8731**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
30	2			0.3008	0.3008		
60	4		0.6016			0.6016	0.6016
>60	5						
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**					
0	0						
30	1			0.0962	0.0962	0.0962	0.0962
120	4		0.3848				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0		0.000		0.000	0.000	
Type 2 Alarm - Manual Alarm	2			0.235			0.235
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000	0.000	0.000	0.000	0.000
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Extinguisher	3			0.0144	0.0144	0.0144	
Fire Hose Reel and Extinguisher	5						0.024
E - Emergency Power Supply		**0.0158**					

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			50	50	50	50	50
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884	
Fire Hydrant System	5						0.1105
H1 - Number of Escape Routes		**0.0196**					
Required Number							
1	1		0.0196				
2	2			0.0392	0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**					
Width							
Width < 1000 mm	0		0.000				
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
≤ 20 m	5		0.0995	0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
≤ 50 m	5		0.0995	0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			50	50	50	50	50
Surface							
Ceilings	2			0.0908	0.0908	0.0908	0.0908
Walls and Ceilings	4		0.1816				
H10 - Signage		**0.0051**					
Extent							
Fire Exit Signs	1				0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153	0.0153			
Flashing Illuminated Exit Signs	5						
Total Fire Safety Features (FSF)		**0.8116**	**1.716**	**1.489**	**1.243**	**1.544**	**1.811**
Fire Safety Index		**1.00**	**2.456**	**2.229**	**1.984**	**2.285**	**2.684**

Appendix AZ – Fire Safety Index Calculations – PG: CL (≤ 4m, ≤ 100 occupants)

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			100	100	100	100	100
Density			1	1	1/5	1	1/20
Area	m^2		100	100	500	100	2000
Height	m		< 4	3 m	3 m	3 m	3 m
Alarm			2	2			2
Storeys			2	Double	Double	Double	Double
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Crowd Purpose Groups							
Entertainment & Public Assembly	3		0.0996	0.0996			
Theatrical & Indoor Sport	3						
Places of Instruction	3				0.0996		
Worship	3					0.0996	
Museum	3						0.0996
BU2 - Building Escape Height		**0.0663**					
< 4m			0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
51 < Occ. No. ≤ 100	4		0.0884	0.0884	0.0884	0.0884	0.0884
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	
1	5						0.3315
Total Building Use Score (BUS)		**0.1879**	**0.7184**	**0.7184**	**0.7184**	**0.7184**	**0.851**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
30	2				0.3008		
60	4		0.6016	0.6016		0.6016	0.6016
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**					

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			100	100	100	100	100
30	1			0.0962	0.0962	0.0962	0.0962
120	4		0.3848				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0				0.000	0.000	
Type 2 Alarm - Manual Alarm	2		0.235	0.235			0.235
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000	0.000	0.000	0.000	
Manual Natural Ventilation	1						0.020
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Extinguisher	3			0.0144	0.0144	0.0144	
Fire Hose Reel and Extinguisher	5						0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884	

Purpose Group			CS	A1, A2	A3	A4	C2
Occupants			100	100	100	100	100
Fire Hydrant System	5						0.1105
H1 - Number of Escape Routes		**0.0196**					
Required Number							
2	2		0.0392	0.0392	0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
≤ 20 m	5		0.0796	0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
≤ 50 m	5		0.0995	0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	2			0.0908	0.0908	0.0908	0.0908
Walls and Ceilings	4		0.1816				
H10 - Signage		**0.0051**					
Extent							
Fire Exit Signs	1				0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153	0.0153			
Total Fire Safety Features (FSF)		**0.8116**	**1.970**	**1.789**	**1.243**	**1.544**	**1.831**
Fire Safety Index		**1.00**	**2.688**	**2.508**	**1.962**	**2.262**	**2.682**

Appendix BA – Fire Safety Index Calculations – PG: CL (≤ 4m, ≤ 500 occupants)

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			500	500	500	500	500
Density			1	1	1/5	1	1/20
Area	m^2		500	500	2500	500	10000
Height	m		< 4	3 m	3 m	3 m	3 m
Alarm			3	2			2, SP
Storeys			2	Double	Double	Double	Double
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Crowd Purpose Groups							
Entertainment & Public Assembly	3		0.0996	0.0996			
Theatrical & Indoor Sport	3						
Places of Instruction	3				0.0996		
Worship	3					0.0996	
Museum	3						0.0996
BU2 - Building Escape Height		**0.0663**					
< 4m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
101 < Occ. No. ≤ 500	3		0.0663	0.0663	0.0663	0.0663	0.0663
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	
1	5						0.3315
Total Building Use Score (BUS)		**0.1879**	**0.6963**	**0.6963**	**0.6963**	**0.6963**	**0.8289**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
30	2				0.3008		
60	4		0.6016	0.6016		0.6016	0.6016
>60	5						
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**					
0	0						
30	1			0.0962	0.0962	0.0962	0.0962
120	4		0.3848				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0				0.000	0.000	
Type 2 Alarm - Manual Alarm	2			0.235			0.235
Type 3 Alarm - Automatic Alarm with Heat Detectors	3		0.3528				
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000	0.000	0.000	0.000	

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			500	500	500	500	500
Automatic Natural Ventilation	4						0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	
Wet Pipe Sprinkler System	5						0.357
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	
Class A	5						0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1		0.0266	0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884	
Fire Hydrant System	5						0.1105
H1 - Number of Escape Routes		**0.0196**					
Required Number							
2	2		0.0392				
3	3			0.0588	0.0588	0.0588	0.0588
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255	0.0255

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			500	500	500	500	500
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
20 < DEOP ≤ 25 m	4		0.0796				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
50 < TOP ≤ 60 m	4		0.0796				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088	0.1088
PP ≤ 30 m	5						
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	1						0.0454
Ceilings	2			0.0908	0.0908	0.0908	
Walls and Ceilings	4		0.1816				
H10 - Signage		**0.0051**					
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**2.068**	**1.819**	**1.283**	**1.583**	**2.327**
Fire Safety Index		**1.00**	**2.764**	**2.515**	**1.979**	**2.280**	**3.156**

Appendix BB – Fire Safety Index Calculations – PG: CL (≤ 4m, ≤ 1000 occupants)

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1000	1000	1000	1000	1000
Density			1	1	1/5	1	1/20
Area	m^2		1000	1000	5000	1000	20000
Max. Area							10000
Max. Occupants							500
Alarm			4	2			2, SP
Height	m		< 4	3 m	3 m	3 m	3 m
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Crowd Purpose Groups							
Entertainment & Public Assembly	3		0.0996	0.0996			
Theatrical & Indoor Sport	3						
Places of Instruction	3				0.0996		

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1000	1000	1000	1000	1000
Worship	3					0.0996	
Museum	3						0.0996
BU2 - Building Escape Height		**0.0663**					
< 4m	5		0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
501 < Occ. No. ≤ 1000	2		0.0442	0.0442	0.0442	0.0442	
101 < Occ. No. ≤ 500	3						0.0663
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	
1	5						0.3315
Total Building Use Score (BUS)		**0.1879**	**0.6742**	**0.6742**	**0.6742**	**0.6742**	**0.8289**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
30	2				0.3008		
60	4		0.6016	0.6016		0.6016	0.6016
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**					
30	1			0.0962	0.0962	0.0962	0.0962
120	4		0.3848				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0				0.000	0.000	
Type 2 Alarm - Manual Alarm	2			0.235			0.235
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588				
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000	0.000	0.000	0.000	
Automatic Natural Ventilation	4						0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0		0.000	0.000	0.000	0.000	
Wet Pipe Sprinkler System	5						0.3565
D2 - Water Supply		**0.0190**					
Type							
None	0		0.000	0.000	0.000	0.000	

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1000	1000	1000	1000	1000
Class A	5						0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1			0.0266	0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133				
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884	
Fire Hydrant System	5						0.1105
H1 - Number of Escape Routes		**0.0196**					
Required Number							
3	3		0.0588	0.0588	0.0588	0.0588	0.0588
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.039				
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
30 < DEOP ≤ 45 m	2		0.0398				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
80 < TOP ≤ 110 m	2		0.0398				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1000	1000	1000	1000	1000
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					
Surface							
Ceilings	1						0.0454
Ceilings	2			0.0908	0.0908	0.0908	
Walls and Ceilings	4		0.1816				
H10 - Signage		**0.0051**					
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**2.369**	**1.819**	**1.283**	**1.583**	**2.327**
Fire Safety Index		**1.00**	**3.043**	**2.493**	**1.957**	**2.258**	**3.156**

Appendix BC – Fire Safety Index Calculations – PG: CL (≤ 4m, ≤ 1200 occupants)

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1200	1200	1200	1200	1200
Density			1	1	1/5	1	1
Area	m^2		1200	1200	6000	1200	24000
Max. Area					5000		10000
Max. Occupants					1000		500
Alarm			7	2	SP		2, SP
Height	m		< 4	3 m	3 m	3 m	3 m
			2	Double	Double	Double	Double
	AS	**Weighting**					
BU1 - Purpose Group		**0.0332**					
Crowd Purpose Groups							
Entertainment & Public Assembly	3		0.0996	0.0996			
Theatrical & Indoor Sport	3						
Places of Instruction	3				0.0996		
Worship	3					0.0996	
Museum	3						0.0996
BU2 - Building Escape Height		**0.0663**					
< 4m		5	0.3315	0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**					
>1000	1		0.0221	0.0221		0.0221	
501 < Occ. No. ≤ 1000	2				0.0442		
101 < Occ. No. ≤ 500	3						0.0663
BU4 - Fire Hazard Category		**0.0663**					
2	3		0.1989	0.1989	0.1989	0.1989	

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1200	1200	1200	1200	1200
1	5						0.3315
Total Building Use Score (BUS)		**0.1879**	**0.6521**	**0.6521**	**0.6742**	**0.6521**	**0.8289**
Fire Safety Features							
	AS	**Weighting**					
A1 - Firecell Rating		**0.1504**					
F Rating (Minutes)							
30	2		0.3008		0.3008		
60	4			0.6016		0.6016	0.6016
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**					
30	1			0.0962	0.0962	0.0962	0.0962
60	2		0.1924				
B - Fire Alarm Type		**0.1176**					
Alarm Type							
No Alarm	0				0.000	0.000	
Type 2 Alarm - Manual Alarm	2			0.235			0.235
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588				
C1 - HVAC Control		**0.0368**					
Smoke Control							
None	0		0.000				
Automatic Shutdown	5			0.184	0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**					
Method							
None	0		0.000	0.000	0.000	0.000	
Automatic Natural Ventilation	4						0.080
C3 - Stairwell Pressurisation		**0.0201**					
Protection							
No	0		0.000	0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**					
Type							
None	0			0.000	0.000	0.000	
Wet Pipe Sprinkler System	5		0.3565				0.3565
D2 - Water Supply		**0.0190**					
Type							
None	0			0.000	0.000	0.000	
Class C	2		0.038				
Class A	5						0.095
D3- Occupant Fire Fighting		**0.0048**					
Type							
None	0		0.000				
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**					
Type							
None	0		0.000	0.000	0.000	0.000	0.000

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1200	1200	1200	1200	1200
F - Communication System		**0.0195**					
Type							
None	0			0.000	0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195				
G1 - Alerting		**0.0266**					
Type							
Telephone	1			0.0266	0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133				
G2 - (Firemen's) Lift control		**0.0157**					
Provided							
No	0		0.000	0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**					
Type							
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884	
Fire Hydrant System	5						0.1105
H1 - Number of Escape Routes		**0.0196**					
Required Number							
3	3			0.0588	0.0588	0.0588	0.0588
≥ 4	4		0.0784				
H2 - Width of Escape Routes		**0.0196**					
Width							
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.039				
H3 - Emergency Lighting		**0.0051**					
Extent (SA building occ > 100)							
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**					
Extent							
None	0		0.000	0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**					
Range of DEOP Length							
45 < DEOP ≤ 60 m	1		0.020				
≤ 20 m	5			0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**					
Range of TOP Length							
110 < TOP ≤ 140 m	1		0.020				
≤ 50 m	5			0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**					
Range of PP Length							
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**					
Extent							
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**					

Purpose Group			CL	A1, A2	A3	A4	C2
Occupants			1200	1200	1200	1200	1200
Surface							
Ceilings	1						0.0454
Ceilings	2		0.0908	0.0908	0.0908	0.0908	
H10 - Signage		**0.0051**					
Extent							
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**2.159**	**1.819**	**1.283**	**1.583**	**2.327**
Fire Safety Index		**1.00**	**2.811**	**2.471**	**1.957**	**2.236**	**3.156**

Appendix BD – Fire Safety Index Calculations – PG: CM (0m, ≤ 50 occupants)

Purpose Group			CM	F2	F3	C1
Occupants			50	50	50	50
Density			0.1	1/10	1/20	1/10
Area	m^2		500	500	1000	500
Height	m		0	0 m	0 m	0 m
Alarm Type			2			2
Storeys			1	Single	Single	Single
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Crowd Purpose Groups						
Exhibition Hall	3		0.0996			0.0996
Small Shop	3			0.0996		
Wholesalers Store	3				0.0996	
BU2 - Building Escape Height		**0.0663**				
0m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**				
4	0				0.00	
2	3		0.1989	0.1989		0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7405**	**0.7405**	**0.608**	**0.7405**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
0	0		0.000			
30	2			0.3008		
60	4				0.6016	0.6016
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**				
30	1			0.0962		
60	2		0.1924		0.1924	0.1924

Purpose Group			CM	F2	F3	C1
Occupants			50	50	50	50
B - Fire Alarm Type		**0.1176**				
Alarm Type						
No Alarm	0		0.000	0.000	0.000	
Type 2 Alarm - Manual Alarm	2					0.235
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000	0.000	0.000	0.000
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000	0.000		0.000
Automatic Natural Ventilation	4				0.080	
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000	0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884
H1 - Number of Escape Routes		**0.0196**				
Required Number						
1	1		0.0196			
2	2			0.0392	0.0392	0.0392

Purpose Group			CM	F2	F3	C1
Occupants			50	50	50	50
H2 - Width of Escape Routes		**0.0196**				
Width						
Width < 1000 mm	0		0.000			
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
At Final Exit	2		0.0102	0.0102		
Open Paths and Exitways	5				0.0255	0.0255
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
≤ 20 m	5		0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
≤ 50 m	5		0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
No applied surface finishes, non-combustible surfaces	5					
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	2					0.0908
Walls and Ceilings (or Ceilings Only)	3			0.1362	0.1362	
Walls and Ceilings	4		0.1816			
H10 - Signage		**0.0051**				
Extent						
Fire Exit Signs	1			0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153			
Total Fire Safety Features (FSF)		**0.8116**	**0.906**	**1.099**	**1.592**	**1.701**
Fire Safety Index		**1.00**	**1.647**	**1.839**	**2.133**	**2.442**

Appendix BE – Fire Safety Index Calculations – PG: CM (0m, ≤ 100 occupants)

Purpose Group			CM	F1	F3	C1
Occupants			100	100	100	100
Density			0.1	1/10	1/20	1/10
Area	m^2		1000	1000	2000	1000
Height	m		0	0 m	0 m	0 m
Alarm Type			2	4		2
Storeys			1	Single	Single	Single
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Crowd Purpose Groups						
Exhibition Hall	3					0.0996
Large Shop	3		0.0996	0.0996		
Wholesalers Store	3				0.0996	
BU2 - Building Escape Height		**0.0663**				
0m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
51 < Occ. No. ≤ 100	4		0.0884	0.0884	0.0884	0.0884
BU4 - Fire Hazard Category		**0.0663**				
4	0				0.00	
2	3		0.1989	0.1989		0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7184**	**0.7184**	**0.5195**	**0.7184**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
0	0		0.000			
60	4			0.6016	0.6016	0.6016
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**				
60	2		0.1924	0.1924	0.1924	0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
No Alarm	0				0.000	
Type 2 Alarm - Manual Alarm	2		0.2352			0.2352
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5			0.588		
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			0.000
Automatic Natural Ventilation	4			0.080	0.080	
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000

Purpose Group			CM	F1	F3	C1
Occupants			100	100	100	100
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000	0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hose Run < 75m	4		0.0884	0.0884		0.0884
Fire Hydrant System	5				0.1105	
H1 - Number of Escape Routes		**0.0196**				
Required Number						
2	2		0.0392	0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**				
Width						
Width < 1000 mm	0		0.000			
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
At Final Exit	2		0.0102			
Open Paths and Exitways	5			0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						

Purpose Group			CM	F1	F3	C1
Occupants			100	100	100	100
≤ 20 m	5		0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
≤ 50 m	5		0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	2					0.0908
Walls and Ceilings (or Ceilings Only)	3			0.1362	0.1362	
Walls and Ceilings	4		0.1816			
H10 - Signage		**0.0051**				
Extent						
Fire Exit Signs	1				0.0051	
Illuminated Fire Exit Signs	3		0.0153	0.0153		0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.161**	**2.374**	**1.798**	**1.895**
Fire Safety Index		**1.00**	**1.879**	**3.092**	**2.317**	**2.614**

Appendix BF – Fire Safety Index Calculations – PG: CM (0m, ≤ 500 occupants)

Purpose Group			CM	F1	F3	C1
Occupants			500	500	500	500
Density			0.1	1/10	1/20	1/10
Area	m^2		5000	5000	10000	5000
Height	m		0	0 m	0 m	0 m
Alarm Type			3	4	SP	2
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Crowd Purpose Groups						
Exhibition Hall	3					0.0996
Large Shop	3		0.0996	0.0996		
Wholesalers Store	3				0.0966	
BU2 - Building Escape Height		**0.0663**				
0m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
101 < Occ. No. ≤ 500	3		0.0663	0.0663	0.0663	0.0663
BU4 - Fire Hazard Category		**0.0663**				
4	0				0.00	
2	3		0.1989	0.1989		0.1989

Purpose Group			CM	F1	F3	C1
Occupants			500	500	500	500
Total Building Use Score (BUS)		**0.1879**	**0.6963**	**0.6963**	**0.4974**	**0.6963**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
0	0		0.000			
60	4			0.6016	0.6016	0.6016
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**				
60	2		0.1924	0.1924	0.1924	0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
Type 2 Alarm - Manual Alarm	2					0.2352
Type 3 Alarm - Automatic Alarm with Heat Detectors	3		0.3528			
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5			0.588	0.588	
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
Automatic Natural Ventilation	4		0.080	0.080	0.080	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000			0.000
Wet Pipe Sprinkler System	5			0.3565	0.357	
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000			0.000
Class A	5			0.095	0.095	
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			

Purpose Group			CM	F1	F3	C1
Occupants			500	500	500	500
G1 - Alerting		**0.0266**				
Type						
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hose Run < 75m	4		0.0884			
Fire Hydrant System	5			0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
2	2		0.0392			
3	3			0.0588	0.0588	0.0588
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392			
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
20 < DEOP ≤ 25 m	4		0.0796			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
50 < TOP ≤ 60 m	4		0.0796			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	2			0.0908	0.0908	0.0908
Walls and Ceilings	4		0.1816			
H10 - Signage		**0.0051**				

Purpose Group			CM	F1	F3	C1
Occupants			500	500	500	500
Extent						
Fire Exit Signs	1				0.0051	
Illuminated Fire Exit Signs	3		0.0153	0.0153		0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.374**	**2.822**	**2.811**	**2.017**
Fire Safety Index		**1.00**	**2.070**	**3.518**	**3.309**	**2.714**

Appendix BG – Fire Safety Index Calculations – PG: CM (0m, ≤ 1000 occupants)

Purpose Group			CM	F1	F3	C1
Occupants			1000	1000	1000	1000
Density			0.1	1/10	1/20	1/10
Area	m^2		10000	10000	20000	10000
Height	m		0	0 m	0 m	0 m
Alarm Type			4	4,SP	4, SP	4, SP
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Crowd Purpose Groups						
Exhibition Hall	3					0.0996
Museum	3					
Large Shop	3		0.0996	0.0996		
Wholesalers Store	3				0.0996	
BU2 - Building Escape Height		**0.0663**				
0m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
501 < Occ. No. ≤ 1000	2		0.0442	0.0442	0.0442	0.0442
BU4 - Fire Hazard Category		**0.0663**				
4	0				0.00	
2	3		0.1989	0.1989		0.1989
Total Building Use Score (BUS)		**0.1879**	**0.6742**	**0.6742**	**0.4753**	**0.6742**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
0	0		0.000			
30	2			0.3008	0.3008	
60	4					0.6016
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**				
60	2		0.1924	0.1924	0.1924	0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**				

Purpose Group			CM	F1	F3	C1
Occupants			1000	1000	1000	1000
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
Automatic Natural Ventilation	4		0.0804	0.080	0.080	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000			
Wet Pipe Sprinkler System	5			0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000			
Class A	5			0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 – Alerting		**0.0266**				
Type						
Telephone	1			0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133			
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hose Run < 75m	4		0.0884			
Fire Hydrant System	5			0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
3	3		0.0588			
≥ 4	4			0.0784	0.0784	0.0784
H2 - Width of Escape Routes		**0.0196**				

Purpose Group			CM	F1	F3	C1
Occupants			1000	1000	1000	1000
Width						
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.039			
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
30 < DEOP ≤ 45 m	2		0.0398			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
80 < TOP ≤ 110 m	2		0.0398			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	1					0.0454
Ceilings	2			0.0908	0.0908	
Walls and Ceilings	4		0.1816			
H10 – Signage		**0.0051**				
Extent						
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153
Flashing Illuminated Exit Signs	5					
Total Fire Safety Features (FSF)		**0.8116**	**1.655**	**2.540**	**2.540**	**2.796**
Fire Safety Index		**1.00**	**2.330**	**3.215**	**3.016**	**3.470**

Appendix BH – Fire Safety Index Calculations – PG: CM (0m, ≤ 1200 occupants)

Purpose Group			CM	F1	F3	C1
Occupants			1200	1200	1200	1200
Density			0.1	1/10	1/20	1/10
Area	m^2		12000	12000	24000	12000
Height	m		0	0 m	0 m	0 m
Alarm Type			7	4, SP	4, SP	

Purpose Group			CM	F1	F3	C1
Occupants			1200	1200	1200	1200
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Crowd Purpose Groups						
Exhibition Hall	3					0.0996
Museum	3					
Large Shop	3		0.0996	0.0996		
Wholesalers Store	3				0.0996	
BU2 - Building Escape Height		**0.0663**				
0m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
>1000	1		0.0221	0.0221	0.0221	0.0221
BU4 - Fire Hazard Category		**0.0663**				
4	0				0.00	
2	3		0.1989	0.1989		0.1989
Total Building Use Score (BUS)		**0.1879**	**0.6521**	**0.6521**	**0.4532**	**0.6521**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
0	0		0.000			
60	4			0.6016	0.6016	0.6016
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**				
60	2		0.1924	0.1924	0.1924	0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**				
Type						
Class C	2		0.038			

Purpose Group			CM	F1	F3	C1
Occupants			1200	1200	1200	1200
Class A	5			0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1			0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133			
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hydrant System	5		0.1105	0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
≥ 4	4		0.0784	0.0784	0.0784	0.0784
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.039			
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
45 < DEOP ≤ 60 m	1		0.0199			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
110 < TOP ≤ 140 m	1		0.0199			
≤ 50 m	5			0.0995	0.0995	0.0995

Purpose Group			CM	F1	F3	C1
Occupants			1200	1200	1200	1200
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	1					0.0454
Ceilings	2		0.0908	0.0908	0.0908	
H10 - Signage		**0.0051**				
Extent						
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.881**	**2.841**	**2.841**	**2.796**
Fire Safety Index		**1.00**	**2.533**	**3.493**	**3.294**	**3.448**

Appendix BI – Fire Safety Index Calculations – PG: CM (≤ 4m, ≤ 50 occupants)

Purpose Group			CM	F2	F3	C1
Occupants			50	50	50	50
Density			0.1	1/10	1/20	1/10
Area	m^2		500	500	1000	500
Height	m		< 4	3 m	3 m	3 m
Alarm Type			2			2
Storeys			2	Double	Double	Double
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Crowd Purpose Groups						
Exhibition Hall	3		0.0996			0.0996
Small Shop	3			0.0996		
Wholesalers Store	3				0.0996	
BU2 - Building Escape Height		**0.0663**				
< 4m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**				
4	0				0.00	
2	3		0.1989	0.1989		0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7405**	**0.7405**	**0.5416**	**0.7405**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				

Purpose Group			CM	F2	F3	C1
Occupants			50	50	50	50
F Rating (Minutes)						
60	4		0.6016	0.6016		
>60	5				0.752	0.752
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**				
30	1			0.0962		
60	2				0.1924	0.1924
120	4		0.3848			
B - Fire Alarm Type		**0.1176**				
Alarm Type						
No Alarm	0		0.000	0.000	0.000	
Type 2 Alarm - Manual Alarm	2					0.235
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000	0.000		0.000
Automatic Natural Ventilation	4				0.080	
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000	0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						

Purpose Group			CM	F2	F3	C1
Occupants			50	50	50	50
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884	0.0884
H1 - Number of Escape Routes		**0.0196**				
Required Number						
1	1		0.0196			
2	2			0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**				
Width						
Width < 1000 mm	0		0.000			
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Exitways	4			0.0204		
Open Paths and Exitways	5		0.0255		0.0255	0.0255
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
≤ 20 m	5		0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
≤ 50 m	5		0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	2					0.0908
Walls and Ceilings (or Ceilings Only)	3			0.1362	0.1362	
Walls and Ceilings	4		0.1816			
H10 - Signage		**0.0051**				
Extent						
Fire Exit Signs	1			0.0051	0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153			
Total Fire Safety Features (FSF)		**0.8116**	**1.716**	**1.594**	**1.926**	**2.035**
Fire Safety Index		**1.00**	**2.456**	**2.334**	**2.468**	**2.776**

Appendix BJ – Fire Safety Index Calculations – PG: CM (≤ 4m, ≤ 100 occupants)

Purpose Group			CM	F1	F3	C1
Occupants			100	100	100	100
Density			0.1	1/10	1/20	1/10
Area	m^2		1000	1000	2000	1000
Height	m		< 4	3 m	3 m	3 m
Alarm Type			2	4		2
Storeys			2	Double	Double	Double
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Crowd Purpose Groups						
Exhibition Hall	3					0.0996
Large Shop	3		0.0996	0.0996		
Wholesalers Store	3				0.0996	
BU2 - Building Escape Height		**0.0663**				
< 4m			0.3315	0.3315	0.3315	0.3315
0m						
BU3 - Occupant Numbers		**0.0221**				
51 < Occ. No. ≤ 100	4		0.0884	0.0884	0.0884	0.0884
BU4 - Fire Hazard Category		**0.0663**				
4	0				0.00	
2	3		0.1989	0.1989		0.1989
Total Building Use Score (BUS)		**0.1879**	**0.7184**	**0.7184**	**0.5195**	**0.7184**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
60	4		0.6016			
>60	5			0.752	0.752	0.752
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**				
60	2			0.1924	0.1924	0.1924
120	4		0.3848			
B - Fire Alarm Type		**0.1176**				
Alarm Type						
No Alarm	0				0.000	
Type 2 Alarm - Manual Alarm	2		0.2352			0.2352
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5			0.588		
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			0.000
Automatic Natural Ventilation	4			0.080	0.080	
C3 - Stairwell Pressurisation		**0.0201**				

Purpose Group			CM	F1	F3	C1
Occupants			100	100	100	100
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0		0.000	0.000	0.000	0.000
D2 - Water Supply		**0.0190**				
Type						
None	0		0.000	0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hose Run < 75m	4		0.0884			
Fire Hydrant System	5			0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
2	2		0.0392	0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						

Purpose Group			CM	F1	F3	C1
Occupants			100	100	100	100
≤ 20 m	5		0.0995	0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
≤ 50 m	5		0.0995	0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	2					0.0908
Walls and Ceilings (or Ceilings Only)	3			0.1362	0.1362	
Walls and Ceilings	4		0.1816			
H10 - Signage		**0.0051**				
Extent						
Fire Exit Signs	1				0.0051	
Illuminated Fire Exit Signs	3		0.0153	0.0153		0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.990**	**2.546**	**1.948**	**2.068**
Fire Safety Index		**1.00**	**2.708**	**3.265**	**2.468**	**2.786**

Appendix BK – Fire Safety Index Calculations – PG: CM (≤ 4m, ≤ 500 occupants)

Purpose Group			CM	F1	F3	C1
Occupants			500	500	500	500
Density			0.1	1/10	1/20	1/10
Area	m^2		5000	5000	10000	5000
Max. Area					5000	3 m
Max. Occupants					250	
Height	m		< 4	3 m	3 m	3 m
Alarm Type			6	4	SP	2
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Crowd Purpose Groups						
Exhibition Hall	3					0.0996
Large Shop	3		0.0996	0.0996		
Wholesalers Store	3				0.0996	
BU2 - Building Escape Height		**0.0663**				
< 4m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
101 < Occ. No. ≤ 500	3		0.0663	0.0663	0.0663	0.0663
BU4 - Fire Hazard Category		**0.0663**				

Purpose Group			CM	F1	F3	C1
Occupants			500	500	500	500
4	0				0.00	
2	3		0.1989	0.1989		0.1989
Total Building Use Score (BUS)		**0.1879**	**0.6963**	**0.6963**	**0.4974**	**0.6963**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
30	2		0.3008			
>60	5			0.752	0.752	0.752
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**				
60	2		0.1924	0.1924	0.1924	0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
Type 2 Alarm - Manual Alarm	2		0.235			0.2352
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5			0.588	0.588	
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.080	0.080	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
None	0					0.000
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.357	
D2 - Water Supply		**0.0190**				
Type						
None	0					0.000
Class C	2		0.038			
Class A	5			0.095	0.095	
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				

Purpose Group			CM	F1	F3	C1
Occupants			500	500	500	500
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1		0.0266	0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hydrant System	5		0.1105	0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
2	2		0.0392		0.0392	
3	3			0.0588		0.0588
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.0392			
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
30 < DEOP ≤ 45 m	2		0.0398			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
80 < TOP ≤ 110 m	2		0.0398			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	2		0.0908	0.0908	0.0908	0.0908

Purpose Group			CM	F1	F3	C1
Occupants			500	500	500	500
H10 – Signage		**0.0051**				
Extent						
Fire Exit Signs	1				0.0051	
Illuminated Fire Exit Signs	3		0.0153	0.0153		0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.723**	**2.972**	**2.942**	**2.168**
Fire Safety Index		**1.00**	**2.419**	**3.668**	**3.440**	**2.864**

Appendix BL – Fire Safety Index Calculations – PG: CM (≤ 4m, ≤ 1000 occupants)

Purpose Group			CM	F1	F3	C1
Occupants			1000	1000	1000	1000
Density			0.1	1/10	1/20	1/10
Area	m^2		10000	10000	20000	10000
Max. Area				5000	5000	
Max. Occupants				500	250	
Height	m		< 4	3 m	3 m	3 m
Alarm Type			6	4,SP	4, SP	4, SP
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Crowd Purpose Groups						
Exhibition Hall	3					0.0996
Large Shop	3		0.0996	0.0996		
Wholesalers Store	3				0.0996	
BU2 - Building Escape Height		**0.0663**				
< 4m	5		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
501 < Occ. No. ≤ 1000	2		0.0442			0.0442
101 < Occ. No. ≤ 500	3			0.0663	0.0663	
BU4 - Fire Hazard Category		**0.0663**				
4	0				0.00	
2	3		0.1989	0.1989		0.1989
Total Building Use Score (BUS)		**0.1879**	**0.6742**	**0.6963**	**0.4974**	**0.6742**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
30	2		0.3008			
60	4			0.6016	0.6016	
>60	5					0.752
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**				
60	2		0.1924	0.1924	0.1924	0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						

Purpose Group			CM	F1	F3	C1
Occupants			1000	1000	1000	1000
Type 2 Alarm - Manual Alarm	2		0.2352			
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5			0.588	0.588	0.588
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.080	0.080	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**				
Type						
Class C	2		0.038			
Class A	5			0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1			0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133			
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hose Run < 75m	4		0.0884			
Fire Hydrant System	5			0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						

Purpose Group			CM	F1	F3	C1
Occupants			1000	1000	1000	1000
2	2				0.0392	
3	3		0.0588	0.0588		
≥ 4	4					0.0784
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.039			
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
30 < DEOP ≤ 45 m	2		0.0398			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
80 < TOP ≤ 110 m	2		0.0398			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	1					0.0454
Ceilings	2		0.0908	0.0908	0.0908	
H10 - Signage		**0.0051**				
Extent						
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.827**	**2.822**	**2.802**	**2.946**
Fire Safety Index		**1.00**	**2.501**	**3.518**	**3.299**	**3.620**

Appendix BM – Fire Safety Index Calculations – PG: CM (≤ 4m, ≤ 1200 occupants)

Purpose Group			CM	F1	F3	C1
Occupants			1200	1200	1200	1200
Density			0.1	1/10	1/20	1/10
Area	m^2		12000	12000	24000	12000
Max. Area				5000	5000	10000
Max. Occupants				500	250	1000
Height	m		< 4	3 m	3 m	3 m
Alarm Type			7	4, SP	4, SP	
	AS	**Weighting**				
BU1 - Purpose Group		**0.0332**				
Crowd Purpose Groups						
Exhibition Hall	3					0.0996
Large Shop	3		0.0996	0.0996		
Wholesalers Store	3				0.0966	
BU2 - Building Escape Height		**0.0663**				
< 4m	3		0.3315	0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**				
>1000	1		0.0221			
501 < Occ. No. ≤ 1000	2					0.0442
101 < Occ. No. ≤ 500	3			0.0663	0.0663	
BU4 - Fire Hazard Category		**0.0663**				
4	0				0.00	
2	3		0.1989	0.1989		0.1989
Total Building Use Score (BUS)		**0.1879**	**0.6521**	**0.6963**	**0.4974**	**0.6742**
Fire Safety Features						
	AS	**Weighting**				
A1 - Firecell Rating		**0.1504**				
F Rating (Minutes)						
30	2		0.3008			
>60	5			0.752	0.752	0.752
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**				
60	2		0.1924	0.1924	0.1924	0.1924
B - Fire Alarm Type		**0.1176**				
Alarm Type						
Type 4 Alarm - Automatic Alarm with Smoke Detectors	5		0.588	0.588	0.588	0.588
C1 - HVAC Control		**0.0368**				
Smoke Control						
None	0		0.000			
Automatic Shutdown	5			0.184	0.184	0.184
C2 - Smoke Extraction		**0.0201**				
Method						
None	0		0.000			
Automatic Natural Ventilation	4			0.0804	0.0804	0.0804
C3 - Stairwell Pressurisation		**0.0201**				
Protection						

Purpose Group			CM	F1	F3	C1
Occupants			1200	1200	1200	1200
No	0		0.000	0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**				
Type						
Wet Pipe Sprinkler System	5		0.3565	0.3565	0.3565	0.3565
D2 - Water Supply		**0.0190**				
Type						
Class C	2		0.038			
Class A	5			0.095	0.095	0.095
D3- Occupant Fire Fighting		**0.0048**				
Type						
None	0		0.000			
Fire Hose Reel and Extinguisher	5			0.024	0.024	0.024
E - Emergency Power Supply		**0.0158**				
Type						
None	0		0.000	0.000	0.000	0.000
F - Communication System		**0.0195**				
Type						
None	0			0.000	0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195			
G1 - Alerting		**0.0266**				
Type						
Telephone	1			0.0266	0.0266	0.0266
Direct Connection to Fire Service	5		0.133			
G2 - (Firemen's) Lift control		**0.0157**				
Provided						
No	0		0.000	0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**				
Type						
Fire Hydrant System	5		0.1105	0.1105	0.1105	0.1105
H1 - Number of Escape Routes		**0.0196**				
Required Number						
2	2				0.0392	
3	3			0.0588		
≥ 4	4		0.0784			0.0784
H2 - Width of Escape Routes		**0.0196**				
Width						
1000 mm ≤ Width < 2000 mm	1			0.0196	0.0196	0.0196
2000 mm ≤ Width < 4500mm	2		0.039			
H3 - Emergency Lighting		**0.0051**				
Extent (SA building occ > 100)						
Open Paths and Exitways	5		0.0255	0.0255	0.0255	0.0255
H4 - Refuge Areas		**0.0026**				
Extent						
None	0		0.000	0.000	0.000	0.000

Purpose Group			CM	F1	F3	C1
Occupants			1200	1200	1200	1200
H5- Dead End Open Path (DEOP) Length		**0.0199**				
Range of DEOP Length						
45 < DEOP ≤ 60 m	1		0.0199			
≤ 20 m	5			0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**				
Range of TOP Length						
110 < TOP ≤ 140 m	1		0.0199			
≤ 50 m	5			0.0995	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**				
Range of PP Length						
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**				
Extent						
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**				
Surface						
Ceilings	1					0.0454
Ceilings	2		0.0908	0.0908	0.0908	
H10 - Signage		**0.0051**				
Extent						
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**2.181**	**2.972**	**2.952**	**2.946**
Fire Safety Index		**1.00**	**2.833**	**3.668**	**3.450**	**3.620**

Appendix BN – Fire Safety Index Calculations – PG: SA (0m, ≤ 40 occupants)

Purpose Group			SA	H1	H2
Occupants			40	40	40
Density			2/Bed	2/Bed	1/5
Area	m^2		-	-	250
Height	m		0	0 m	0 m
Alarm			5af		
Storeys			1	Single	Single
	AS	**Weighting**			
BU1 - Purpose Group		**0.0332**			
Sleeping Purpose Groups					
Hotel	1		0.0332	0.0332	
Dormitory	1				0.0332
BU2 - Building Escape Height		**0.0663**			
0m	5		0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**			
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105

Purpose Group			SA	H1	H2
Occupants			40	40	40
BU4 - Fire Hazard Category		**0.0663**			
1	5		0.3315	0.3315	0.3315
Total Building Use Score (BUS)		**0.1879**	**0.8067**	**0.8067**	**0.8067**
Fire Safety Features					
	AS	**Weighting**			
A1 - Firecell Rating		**0.1504**			
F Rating (Minutes)					
0	0		0.000		
30	2			0.3008	0.3008
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**			
0	0				
30	1			0.0962	0.0962
60	2		0.1924		
B - Fire Alarm Type		**0.1176**			
Alarm Type					
No Alarm	0		0.000	0.000	0.000
C1 - HVAC Control		**0.0368**			
Smoke Control					
None	0		0.000	0.000	0.000
C2 - Smoke Extraction		**0.0201**			
Method					
None	0		0.000	0.000	0.000
C3 - Stairwell Pressurisation		**0.0201**			
Protection					
No	0		0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**			
Type					
None	0		0.000	0.000	0.000
D2 - Water Supply		**0.0190**			
Type					
None	0		0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**			
Type					
None	0		0.000		
Fire Hose Reel and Extinguisher	5			0.024	0.024
E - Emergency Power Supply		**0.0158**			
Type					
None	0		0.000	0.000	0.000
F - Communication System		**0.0195**			
Type					
None	0			0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195		

Purpose Group			SA	H1	H2
Occupants			40	40	40
G1 - Alerting		**0.0266**			
Type					
Telephone	1		0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**			
Provided					
No	0		0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**			
Type					
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884
H1 - Number of Escape Routes		**0.0196**			
<10m USP; <25m SP: Internal					
1	1		0.0196		
2	2			0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**			
Width					
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**			
Extent (SA building occ > 100)					
None	0			0.000	0.000
At Final Exit	2		0.0102		
H4 - Refuge Areas		**0.0026**			
Extent					
None	0		0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**			
Range of DEOP Length					
≤ 20 m	5		0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**			
Range of TOP Length					
≤ 50 m	5		0.0796	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**			
Range of PP Length					
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**			
Extent					
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**			
Surface					
Ceilings	2			0.0908	0.0908
Walls and Ceilings (or Ceilings Only)	3		0.1362		
H10 - Signage		**0.0051**			
Extent					
Fire Exit Signs	1			0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153		

Purpose Group			SA	H1	H2
Occupants			40	40	40
Total Fire Safety Features (FSF)		**0.8116**	**0.861**	**1.043**	**1.043**
Fire Safety Index		**1.00**	**1.667**	**1.850**	**1.850**

Appendix BO – Fire Safety Index Calculations – PG: SA (0m, ≤ 160 occupants)

Purpose Group			SA	H1	H2
Occupants			160	160	160
Density			2/Bed	2/Bed	1/5
Area	m^2		-	-	800
Height	m		0	0 m	0 m
Alarm			7		
Storeys			1	Single	Single
	AS	**Weighting**			
BU1 - Purpose Group		**0.0332**			
Sleeping Purpose Groups					
Hotel	1		0.0332	0.0332	
Dormitory	1				0.0332
BU2 - Building Escape Height		**0.0663**			
0m	5		0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**			
101 < Occ. No. ≤ 500	3		0.0663	0.0663	0.0663
BU4 - Fire Hazard Category		**0.0663**			
1	5		0.3315	0.3315	0.3315
Total Building Use Score (BUS)		**0.1879**	**0.7625**	**0.7625**	**0.7625**
Fire Safety Features					
	AS	**Weighting**			
A1 - Firecell Rating		**0.1504**			
F Rating (Minutes)					
0	0		0.000		
30	2			0.3008	0.3008
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**			
0	0				
30	1		0.0962	0.0962	0.0962
B - Fire Alarm Type		**0.1176**			
Alarm Type					
No Alarm	0			0.000	0.000
Type 5 Alarm - Automatic Alarm with Heat and Local Smoke Detectors	4		0.4704		
C1 - HVAC Control		**0.0368**			
Smoke Control					
None	0		0.000		
Automatic Shutdown	5			0.184	0.184

Purpose Group			SA	H1	H2
Occupants			160	160	160
C2 - Smoke Extraction		**0.0201**			
Method					
None	0		0.000	0.0000	0.000
C3 - Stairwell Pressurisation		**0.0201**			
Protection					
No	0		0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**			
Type					
None	0			0.000	0.000
Wet Pipe Sprinkler System	5		0.3565		
D2 - Water Supply		**0.0190**			
Type					
None	0			0.000	0.000
Class C	2		0.038		
D3- Occupant Fire Fighting		**0.0048**			
Type					
None	0		0.000		
E - Emergency Power Supply		**0.0158**			
Type					
None	0		0.000	0.000	0.000
F - Communication System		**0.0195**			
Type					
None	0			0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195		
G1 - Alerting		**0.0266**			
Type					
Telephone	1		0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**			
Provided					
No	0		0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**			
Type					
Fire Hose Run < 75m	4		0.0884		0.0884
Fire Hydrant System	5			0.1105	
H1 - Number of Escape Routes		**0.0196**			
<10m USP; <25m SP: Internal					
2	2		0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**			
Width					
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**			
Extent (SA building occ > 100)					
At Final Exit	2		0.0102		
Exitways	4			0.0204	0.0204

Purpose Group			SA	H1	H2
Occupants			160	160	160
H4 - Refuge Areas		**0.0026**			
Extent					
None	0		0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**			
Range of DEOP Length					
30 < DEOP ≤ 45 m	2		0.0398		
≤ 20 m	5			0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**			
Range of TOP Length					
80 < TOP ≤ 110 m	2		0.0398		
≤ 50 m	5			0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**			
Range of PP Length					
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**			
Extent					
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**			
Surface					
Ceilings	1		0.0454		
Ceilings	2			0.0908	0.0908
H10 - Signage		**0.0051**			
Extent					
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.459**	**1.280**	**1.258**
Fire Safety Index		**1.00**	**2.221**	**2.043**	**2.020**

Appendix BP – Fire Safety Index Calculations – PG: SA (≤ 4m, ≤ 40 occupants)

Purpose Group			SA	H1	H2
Occupants			40	50	50
Density			2/Bed	2/Bed	1/5
Area	m^2		-	-	250
Height	m		< 4	3 m	3 m
Alarm			5f		
Storeys			2	Double	Double
	AS	**Weighting**			
BU1 - Purpose Group		**0.0332**			
Sleeping Purpose Groups					
Hotel	1		0.0332	0.0332	
Dormitory	1				0.0332
BU2 - Building Escape Height		**0.0663**			
< 4m	5		0.3315	0.3315	0.3315

Purpose Group			SA	H1	H2
Occupants			40	50	50
BU3 - Occupant Numbers		**0.0221**			
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**			
1	5		0.3315	0.3315	0.3315
Total Building Use Score (BUS)		**0.1879**	**0.8067**	**0.8067**	**0.8067**
Fire Safety Features					
	AS	**Weighting**			
A1 - Firecell Rating		**0.1504**			
F Rating (Minutes)					
30	2				0.3008
45	3		0.4512		
60	4			0.6016	
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**			
30	1			0.0962	0.0962
90	3		0.2886		
B - Fire Alarm Type		**0.1176**			
Alarm Type					
No Alarm	0			0.000	0.000
Type 5 Alarm - Automatic Alarm with Heat and Local Smoke Detectors	4		0.470		
C1 - HVAC Control		**0.0368**			
Smoke Control					
None	0		0.000		
Automatic Shutdown	5			0.184	0.184
C2 - Smoke Extraction		**0.0201**			
Method					
None	0		0.000	0.000	0.000
C3 - Stairwell Pressurisation		**0.0201**			
Protection					
No	0		0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**			
Type					
None	0		0.000	0.000	0.000
D2 - Water Supply		**0.0190**			
Type					
None	0		0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**			
Type					
None	0		0.000		
Fire Hose Reel and Extinguisher	5			0.024	0.024
E - Emergency Power Supply		**0.0158**			
Type					
None	0		0.000	0.000	0.000

Purpose Group			SA	H1	H2
Occupants			40	50	50
F - Communication System		**0.0195**			
Type					
None	0			0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195		
G1 - Alerting		**0.0266**			
Type					
Telephone	1		0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**			
Provided					
No	0		0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**			
Type					
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884
H1 - Number of Escape Routes		**0.0196**			
<10m USP; <25m SP: Internal					
1	1		0.0196		
2	2			0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**			
Width					
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**			
Extent (SA building occ > 100)					
None	0			0.000	0.000
Exitways	4		0.0204		
H4 - Refuge Areas		**0.0026**			
Extent					
None	0		0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**			
Range of DEOP Length					
≤ 20 m	5		0.0995	0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**			
Range of TOP Length					
≤ 50 m	5		0.0796	0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**			
Range of PP Length					
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**			
Extent					
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**			
Surface					
Ceilings	2			0.0908	
Walls and Ceilings (or Ceilings Only)	3		0.1362		0.1362

Purpose Group			SA	H1	H2
Occupants			40	50	50
H10 - Signage		**0.0051**			
Extent					
Fire Exit Signs	1			0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153		
Total Fire Safety Features (FSF)		**0.8116**	**1.889**	**1.528**	**1.273**
Fire Safety Index		**1.00**	**2.695**	**2.335**	**2.079**

Appendix BQ – Fire Safety Index Calculations – PG: SA (≤ 4m, ≤ 160 occupants)

Purpose Group			SA	H1	H2
Occupants			160	160	160
Density			2/Bed	2/Bed	1/5
Area	m^2		-	-	800
Height	m		< 4	3 m	3 m
Alarm			7		
Storeys			2	Double	Double
	AS	**Weighting**			
BU1 - Purpose Group		**0.0332**			
Sleeping Purpose Groups					
Hotel	1		0.0332	0.0332	
Dormitory	1				0.0332
BU2 - Building Escape Height		**0.0663**			
< 4m	5		0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**			
101 < Occ. No. ≤ 500	3		0.0663	0.0663	0.0663
BU4 - Fire Hazard Category		**0.0663**			
1	5		0.3315	0.3315	0.3315
Total Building Use Score (BUS)		**0.1879**	**0.7625**	**0.7625**	**0.7625**
Fire Safety Features					
	AS	**Weighting**			
A1 - Firecell Rating		**0.1504**			
F Rating (Minutes)					
30	2		0.3008		0.3008
60	4			0.6016	
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**			
30	1			0.0962	0.0962
60	2		0.1924		
B - Fire Alarm Type		**0.1176**			
Alarm Type					
No Alarm	0			0.000	0.000
Type 5 Alarm - Automatic Alarm with Heat and Local Smoke Detectors	4		0.4704		

Purpose Group			SA	H1	H2
Occupants			160	160	160
C1 - HVAC Control		**0.0368**			
Smoke Control					
None	0		0.000		
Automatic Shutdown	5			0.184	0.184
C2 - Smoke Extraction		**0.0201**			
Method					
None	0		0.000	0.0000	0.000
C3 - Stairwell Pressurisation		**0.0201**			
Protection					
No	0		0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**			
Type					
None	0			0.000	0.000
Wet Pipe Sprinkler System	5		0.3565		
D2 - Water Supply		**0.0190**			
Type					
None	0			0.000	0.000
Class C	2		0.038		
D3- Occupant Fire Fighting		**0.0048**			
Type					
None	0		0.000		
Fire Hose Reel and Extinguisher	5			0.024	0.024
E - Emergency Power Supply		**0.0158**			
Type					
None	0		0.000	0.000	0.000
F - Communication System		**0.0195**			
Type					
None	0			0.000	0.000
Evacuation Plan & Fire Wardens	1		0.0195		
G1 - Alerting		**0.0266**			
Type					
Telephone	1		0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**			
Provided					
No	0		0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**			
Type					
Fire Hose Run < 75m	4		0.0884		0.0884
Fire Hydrant System	5			0.1105	
H1 - Number of Escape Routes		**0.0196**			
<10m USP; <25m SP: Internal					
2	2		0.0392	0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**			
Width					

Purpose Group			SA	H1	H2
Occupants			160	160	160
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**			
Extent (SA building occ > 100)					
Exitways	4		0.0204	0.0204	0.0204
H4 - Refuge Areas		**0.0026**			
Extent					
None	0		0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**			
Range of DEOP Length					
30 < DEOP ≤ 45 m	2		0.0398		
≤ 20 m	5			0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**			
Range of TOP Length					
80 < TOP ≤ 110 m	2		0.0398		
≤ 50 m	5			0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**			
Range of PP Length					
30 < PP ≤ 45 m	4		0.1088	0.1088	0.1088
H8 - Exitway Surface Finishes		**0.0112**			
Extent					
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**			
Surface					
Ceilings	1		0.0454		
Ceilings	2			0.0908	
Walls and Ceilings (or Ceilings Only)	3				0.1362
H10 - Signage		**0.0051**			
Extent					
Illuminated Fire Exit Signs	3		0.0153	0.0153	0.0153
Total Fire Safety Features (FSF)		**0.8116**	**1.866**	**1.581**	**1.303**
Fire Safety Index		**1.00**	**2.628**	**2.343**	**2.066**

Appendix BR – Fire Safety Index Calculations – PG: SR (0m, ≤ 40 occupants)

Purpose Group			SR	H5	H3
Occupants			40	16	50
Density			2/Bed	4/Room	2/Bed
Area	m^2		-	-	-
Height	m		0	0 m	0 m
Alarm			1		
Storeys			1	Single	Single
	AS	**Weighting**			
BU1 - Purpose Group		**0.0332**			

Purpose Group			SR	H5	H3
Occupants			40	16	50
Sleeping Purpose Groups					
Hospitality	2			0.0664	
Domestic Residence	2		0.0664		0.0664
BU2 - Building Escape Height		**0.0663**			
0m	5		0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**			
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**			
1	5		0.3315	0.3315	0.3315
Total Building Use Score (BUS)		**0.1879**	**0.8399**	**0.8399**	**0.8399**
Fire Safety Features					
	AS	**Weighting**			
A1 - Firecell Rating		**0.1504**			
F Rating (Minutes)					
0	0		0.000		
30	2			0.3008	0.3008
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**			
30	1			0.0962	0.0962
60	2		0.1924		
B - Fire Alarm Type		**0.1176**			
Alarm Type					
No Alarm	0		0.000	0.000	0.000
C1 - HVAC Control		**0.0368**			
Smoke Control					
None	0		0.000	0.000	0.000
C2 - Smoke Extraction		**0.0201**			
Method					
None	0		0.000	0.000	0.000
C3 - Stairwell Pressurisation		**0.0201**			
Protection					
No	0		0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**			
Type					
None	0		0.000	0.000	0.000
D2 - Water Supply		**0.0190**			
Type					
None	0		0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**			
Type					
None	0		0.000	0.000	
Fire Hose Reel and Extinguisher	5				0.024

Purpose Group			SR	H5	H3
Occupants			40	16	50
E - Emergency Power Supply		**0.0158**			
Type					
None	0		0.000	0.000	0.000
F - Communication System		**0.0195**			
Type					
None	0		0.000	0.000	0.000
G1 – Alerting		**0.0266**			
Type					
Telephone	1		0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**			
Provided					
No	0		0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**			
Type					
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884
H1 - Number of Escape Routes		**0.0196**			
<10m USP; <25m SP: Internal					
1	1		0.0196		
2	2			0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**			
Width					
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**			
Extent (SA building occ > 100)					
None	0		0.000	0.000	0.000
H4 - Refuge Areas		**0.0026**			
Extent					
None	0		0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**			
Range of DEOP Length					
20 < DEOP ≤ 25 m	4		0.0796		
≤ 20 m	5			0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**			
Range of TOP Length					
50 < TOP ≤ 60 m	4		0.0597		
≤ 50 m	5			0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**			
Range of PP Length					
45 < PP ≤ 60 m	3		0.0816		
30 < PP ≤ 45 m	4			0.1088	0.109
H8 - Exitway Surface Finishes		**0.0112**			
Extent					
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448

Purpose Group			SR	H5	H3
Occupants			40	16	50
H9 - Occupied Spaces Surface Finishes		**0.0454**			
Surface					
Walls and Ceilings	0		0.000		
Ceilings	1			0.0454	0.0454
H10 – Signage		**0.0051**			
Extent					
Fire Exit Signs	1			0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153		
Total Fire Safety Features (FSF)		**0.8116**	**0.628**	**0.974**	**0.998**
Fire Safety Index		**1.00**	**1.468**	**1.814**	**1.838**

Appendix BS – Fire Safety Index Calculations – PG: SR (≤ 4m, ≤ 40 occupants)

Purpose Group			SR	H5	H3
Occupants			40	16	50
Density			2/Bed	4/Room	2/Bed
Area	m^2		-	-	-
Height	m		< 4	3 m	3 m
Alarm			1, 2af		
Storeys			2	Double	Double
	AS	**Weighting**			
BU1 - Purpose Group		**0.0332**			
Sleeping Purpose Groups					
Hospitality	2			0.0664	
Domestic Residence	2		0.0664		0.0664
BU2 - Building Escape Height		**0.0663**			
< 4m	5		0.3315	0.3315	0.3315
BU3 - Occupant Numbers		**0.0221**			
Occ. No. ≤ 50	5		0.1105	0.1105	0.1105
BU4 - Fire Hazard Category		**0.0663**			
1	5		0.3315	0.3315	0.3315
Total Building Use Score (BUS)		**0.1879**	**0.8399**	**0.8399**	**0.8399**
Fire Safety Features					
	AS	**Weighting**			
A1 - Firecell Rating		**0.1504**			
F Rating (Minutes)					
30	2			0.3008	0.3008
45	3		0.4512		
A2 - Structural Fire Endurance Rating Attribute Score		**0.0962**			
30	1			0.0962	0.0962
90	3		0.2886		
B - Fire Alarm Type		**0.1176**			

Purpose Group			SR	H5	H3
Occupants			40	16	50
Alarm Type					
No Alarm	0		0.000	0.000	0.000
C1 - HVAC Control		**0.0368**			
Smoke Control					
None	0		0.000		
Automatic Shutdown	5			0.184	0.184
C2 - Smoke Extraction		**0.0201**			
Method					
None	0		0.000	0.000	0.000
C3 - Stairwell Pressurisation		**0.0201**			
Protection					
No	0		0.000	0.000	0.000
D1 - Sprinkler System		**0.0713**			
Type					
None	0		0.000	0.000	0.000
D2 - Water Supply		**0.0190**			
Type					
None	0		0.000	0.000	0.000
D3- Occupant Fire Fighting		**0.0048**			
Type					
None	0		0.000	0.000	
Fire Hose Reel and Extinguisher	5				0.024
E - Emergency Power Supply		**0.0158**			
Type					
None	0		0.000	0.000	0.000
F - Communication System		**0.0195**			
Type					
None	0		0.000	0.000	0.000
G1 - Alerting		**0.0266**			
Type					
Telephone	1		0.0266	0.0266	0.0266
G2 - (Firemen's) Lift control		**0.0157**			
Provided					
No	0		0.000	0.000	0.000
G3 - Fire Fighting Access		**0.0221**			
Type					
Fire Hose Run < 75m	4		0.0884	0.0884	0.0884
H1 - Number of Escape Routes		**0.0196**			
<10m USP; <25m SP: Internal					
1	1		0.0196		
2	2			0.0392	0.0392
H2 - Width of Escape Routes		**0.0196**			
Width					

Purpose Group			SR	H5	H3
Occupants			40	16	50
1000 mm ≤ Width < 2000 mm	1		0.0196	0.0196	0.0196
H3 - Emergency Lighting		**0.0051**			
Extent (SA building occ > 100)					
None	0			0.000	
Exitways	4		0.0204		0.0204
H4 - Refuge Areas		**0.0026**			
Extent					
None	0		0.000	0.000	0.000
H5- Dead End Open Path (DEOP) Length		**0.0199**			
Range of DEOP Length					
20 < DEOP ≤ 25 m	4		0.0796		
≤ 20 m	5			0.0995	0.0995
H6 - Total Open Path (TOP) Length		**0.0199**			
Range of TOP Length					
50 < TOP ≤ 60 m	4		0.0597		
≤ 50 m	5			0.0995	0.0995
H7 - Protected Path (PP) Length		**0.0272**			
Range of PP Length					
45 < PP ≤ 60 m	3		0.0816		
30 < PP ≤ 45 m	4			0.1088	0.109
H8 - Exitway Surface Finishes		**0.0112**			
Extent					
SFI = 0, SDI ≤ 3, FI ≤ 12	4		0.0448	0.0448	0.0448
H9 - Occupied Spaces Surface Finishes		**0.0454**			
Surface					
Walls and Ceilings	0		0.000		
Ceilings	2			0.0908	0.0908
H10 - Signage		**0.0051**			
Extent					
Fire Exit Signs	1			0.0051	0.0051
Illuminated Fire Exit Signs	3		0.0153		
Total Fire Safety Features (FSF)		**0.8116**	**1.195**	**1.203**	**1.248**
Fire Safety Index		**1.00**	**2.035**	**2.043**	**2.088**